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FLOOD INSURANCE STUDY

COMPLETED

107

CITY OF CARSON CITY, NEVADA

INDEPENDENT CITY

ORIGINAL

MARCH 4, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 320001

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1

1.1 Purpose of Study 1
1.2 Authority and Acknowledgments 1
1.3 Coordination 1

2.0 AREA STUDIED 2

2.1 Scope of Study 2
2.2 Community Description 5
2.3 Principal Flood Problems 6
2.4 Flood Protection Measures 8

3.0 ENGINEERING METHODS 8

3.1 Hydrologic Analyses 9
3.2 Hydraulic Analyses 9

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS 12

4.1 Flood Boundaries 12
4.2 Floodways 14

5.0 INSURANCE APPLICATION 21

5.1 Reach Determinations 21
5.2 Flood Hazard Factors 22
5.3 Flood Insurance Zones 22
5.4 Flood Insurance Rate Map Description 26

6.0 OTHER STUDIES 27

7.0 LOCATION OF DATA 27

8.0 BIBLIOGRAPHY AND REFERENCES 27

TABLE OF CONTENTS (Cont'd)

Page

FIGURES

Figure 1 - Vicinity Map.. 3
Figure 2 - Floodway Schematic................................... 21

TABLES

Table 1 - Summary of Discharges................................. 10
Table 2 - Manning's "n" Values.................................. 13
Table 3 - Floodway Data... 15
Table 4 - Flood Insurance Zone Data............................. 23

EXHIBITS

Exhibit 1 - Flood Profiles

Carson River	Panels 01P-07P
Clear Creek	Panels 08P-11P
Golf Course Creek A	Panels 12P-13P
Golf Course Creek B	Panels 14P-17P
Kings Canyon Creek	Panels 18P-20P
Goni Canyon Creek	Panels 21P-27P
Eagle Valley Creek	Panels 29P-30P

Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Carson City, Nevada (Independent City), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Boyle Engineering Corporation, for the Federal Emergency Management Agency (FEMA), under Contract No. H-4609. This study was completed in December 1982.

1.3 Coordination

Flooding sources requiring detailed study were identified at a meeting held on July 19, 1979. This meeting was attended by representatives of FEMA, the study contractor, and the community. Coordination with the community and FEMA was maintained throughout the study to ensure that study results would meet agency and community requirements.

On October 16, 1980, the study contractor met with representatives of the Carson City Planning Department, Carson City Department of Public Works, and U.S. Geological Survey (USGS) to discuss flooding problems in Carson City.

A technical coordination meeting was held between representatives of the study contractor and FEMA on September 25, 1981. At the meeting, the results of the hydrologic analyses were discussed and compared with previous studies. The preliminary results of the hydraulic analyses were also reviewed. The discussion centered on the suitability of applying alluvial fan and shallow flooding guidelines or detailed methods to specific flooding sources.

On May 11, 1982, an intermediate community meeting was held in Carson City to discuss preliminary study results. Representatives of FEMA, the study contractor, and the community attended the meeting.

The following were contacted and supplied information used in preparation of this study: U.S. Bureau of Reclamation, U.S. Army Corps of Engineers (COE), USGS, U.S. Soil Conservation Service (SCS), National Weather Service, Nevada Department of Highways, Nevada Department of Conservation and Natural Resources, Desert Research Institute, Carson River Basin Council of Governments, Carson City Planning Department, Carson City Department of Public Works, and Carson City Chamber of Commerce.

The final community coordination meeting was held on September 4, 1984, and was attended by representatives of FEMA, the study contractor, and the city. No problems were raised at the meeting.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the urban areas of the City of Carson City, Nevada (Independent City). The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods:

Carson River, for approximately 5.7 miles downstream of Mexican Dam;

Clear Creek, for approximately 6.2 miles upstream of its confluence with the Carson River;

Golf Course Creek B, for approximately 0.7 mile upstream from its confluence with the Carson River;

Golf Course Creek A, for approximately 0.5 mile upstream from its confluence with Golf Course Creek B;

Kings Canyon Creek, for approximately 6.6 miles upstream from its confluence with the Carson River;

Goni Canyon Creek, from approximately 0.4 mile upstream from its confluence with Kings Canyon Creek upstream to Conestoga Drive;

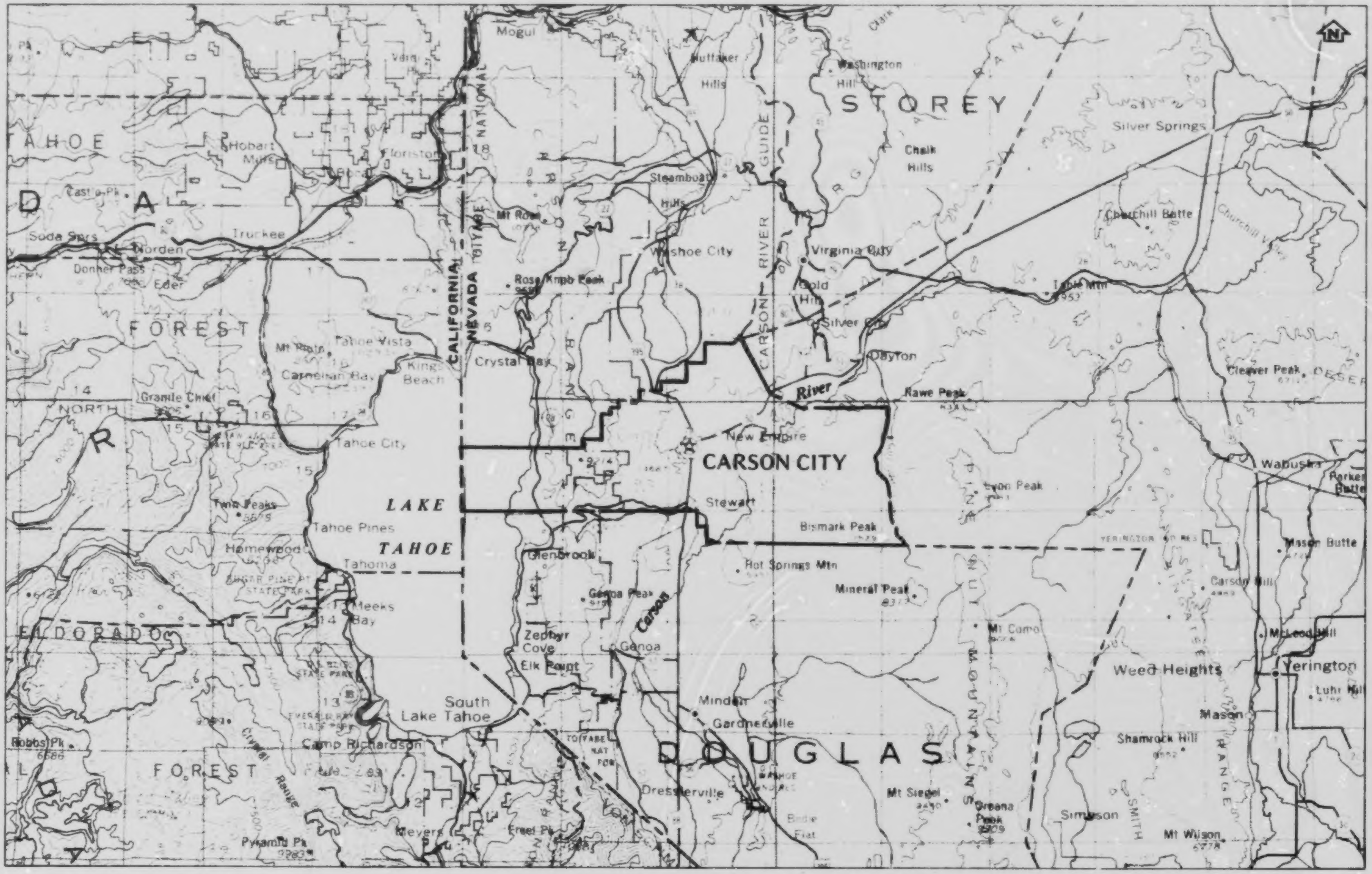
STOREY
CARSON CITY
DOUGLAS
LAKE TAHOE
TAHOE
FOREST
EL DORADO
NORTH
CALIFORNIA
NEVADA
CARSON RANGE
CARSON RIVER
GUIDE
River
Carson
PINE NUT MOUNTAINS
SINGATSE RANGE
SMITH
Mogul
Huffaker Hills
Washington Hill
Chalk Hills
Silver Springs
Steamboat
Steamboat Hills
Hobart Mills
Floriston
Castle Pk
Soda Sprs
Truckee
Norden
Donner Pass
Eder
Mt Rose
Washoe City
Virginia City
Gold Hill
Silver City
Dayton
Churchill Butte
Table Mtn
Rose Knob Peak
Crystal Bay
Kings Beach
Tahoe Vista
Mt Pluto
Carnelian Bay
Granite Chief
Tahoe City
New Empire
Stewart
Rawe Peak
Cleaver Peak
Lyon Peak
Bismark Peak
Wabuska
Parker Butte
Twin Peaks
Tahoe Pines
Homewood
Tahoma
Glenbrook
Hot Springs Mtn
Mineral Peak
Mason Butte
Carson Hill
Sugar Pine Pt State Park
Meeks Bay
Genoa Peak
Mt Como
McLeod Hill
Zephyr Cove
Elk Point
Genoa
Weed Heights
Yerington
Luhr Hill
Minden
Gardnerville
South Lake Tahoe
Mason
Robbs Pk
Camp Richardson
Shamrock Hill
Crystal Range
Dresslerville
Mt Siegel
Oreana Peak
Simpson
Mt Wilson
Pyramid Pk
Meyers
Freel Pk
Toiyabe Nat For
Yerington Ind Res
N

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

APPROXIMATE SCALE
8 0 8 16 24 MILES

VICINITY MAP

Eagle Valley Creek, from Graves Lane upstream to U.S. Highway 395;

Ash Canyon Creek, for approximately 4.3 miles upstream from its confluence with Kings Canyon Creek;

Vicee Canyon Creek, for approximately 3.8 miles upstream from its confluence with Ash Canyon Creek;

Combs Canyon Creek, from its confluence with Ash Canyon Creek upstream to V&T Way;

H Tributary, for approximately 2.3 miles upstream of East Fifth Street;

Voltaire Canyon Creek, for approximately 3.2 miles upstream from its confluence with H Tributary;

Voltaire Split, for approximately 0.8 mile along Koontz Lane between Voltaire Canyon Creek and Saliman Road Tributary;

Saliman Road Tributary, for approximately 2.6 miles upstream from its confluence with H Tributary;

Eagle Extension, for approximately 1.8 miles upstream from its confluence with Goni Canyon Creek; and

F Tributary, for approximately 0.6 mile upstream from its confluence with Eagle Extension.

In addition, a limited-detailed analysis was performed for reaches upstream of the detailed analysis on Clear, Kings Canyon, Ash Canyon, Vicee Canyon, Combs Canyon, and Goni Canyon Creeks. This limited-detailed study, which analyzed the 100-year flood only, was also performed on the entire reach of G Tributary, Kings Split, and Channels C and D.

The areas studied by detailed and limited-detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1987.

Approximate analyses were performed for reaches on the Carson River extending upstream and downstream from the detailed study to the corporate limits. Approximate methods were also used upstream of detailed reaches on H Tributary, Saliman Road Tributary, F Tributary, and Golf Course Creeks A and B, and for reaches along I Tributary, E Tributary, and Prison Hill Creek.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Carson City.

2.2 Community Description

Carson City, the State capital, lies at the west-central edge of Nevada. It is bordered by Washoe and Lyon Counties to the north, Lyon County to the east, Douglas County to the south, and Placer County, California, to the west.

The city population center is located 30 miles south of Reno and 14 miles east of Lake Tahoe. U.S. Highways 50 and 395 intersect in the central business district, providing all-weather access to other points in Nevada and California.

The developed area of Carson City is located in Eagle Valley, an alluvial valley formed by streams draining the Carson and Virginia Ranges. These Carson River tributaries have caused flood damage since the time of the first settlement in the 1850s. Carson City began its growth as a major commercial and transportation center in 1859 with the discovery of the Comstock Lode. Timber from adjacent mountain slopes was logged for use in the mines and new towns that were springing up throughout the area. Denuded watersheds resulted, causing increased flood severity and damage from sediment and debris in Carson City and adjacent areas (Reference 1).

The population of Carson City mushroomed (more than doubling) between 1970 and 1980. In 1980, the population reached 32,022 and was concentrated in the 7.5 square miles that form the Carson City urban core. The economic base for this boom is tourism and light industry. Government services are also an important sector of its economy. New developments that serve the growing population are replacing the traditional land uses of open range and forage crops.

The corporate limits of Carson City encompass what was once Ormsby County. A single city-county organization now governs the approximately 147-square-mile area. The climate within the extensive corporate limits ranges from humid alpine conditions in the Sierra Nevada to semiarid steppe in the valleys to the east. Precipitation in the urban district averages 11.83 inches a year, 75 percent of which falls between October and March. Winter precipitation results from westerly cyclonic storms and can be in the form of rain or snow. Winter temperatures are cool, averaging 35.2°F. However, average daily temperature extremes during the winter vary from a high of 52°F to a low of 23°F. Summers are warm, averaging 66.7°F. Recorded annual temperature extremes range from -18°F to 103°F (Reference 2).

The major sources of flooding in Carson City are the streams that drain the Carson and Virginia Ranges, and flow east-southeast across Eagle Valley to the Carson River. Most of the Carson City urban district lies across these drainageways, which are often shallow and indistinct on the valley floor. The major streams flowing through Eagle Valley from the Carson Range are Clear Creek, Kings Canyon Creek, and Ash Canyon Creek, which flow year round, and Vicee Canyon Creek, Voltaire Canyon Creek, and Combs Canyon Creek, which flow during only part of the year.

Eagle Valley Creek drains a small watershed that is a tributary to Combs Canyon Creek. Goni Canyon Creek and the streams designated as Golf Course Creeks A and B flow south into the valley from the Virginia Range.

These streams discharge into the Carson River, which flows through Carson City at the eastern edge of Eagle Valley. The two forks of the Carson River rise in the Sierra Nevada at elevations of 6,000 to 10,000 feet. They flow north into Nevada and join in the Carson Valley, south of Carson City. The Carson River then flows north-northeast to Lahontan Reservoir. Below Lahontan Dam in Churchill County, all of the water is used for irrigation. The irrigation tailwaters end in the Carson Sink on the Stillwater Wildlife Management Area. The drainage area of the Carson River at Carson City is approximately 876 square miles.

2.3 Principal Flood Problems

Historically, major flood damage to the developed areas of Carson City has been caused by the streams from the Carson and Virginia Ranges, referred to here as the Carson City watershed. The floodflows begin in steep mountain canyons, where they develop high velocities and pick up sediment and debris. When the flows reach Eagle Valley, they spread out in broad streams and drop much of their sediment and debris load. As the flows reach the urban district, they are channeled into the east-west streets, with some backwater and diversions flowing along the north-south grid. The downtown area between Second and John Streets has been flooded consistently in the past (Reference 1). Where flows encounter obstructions such as highway embankments, they pond and cause additional flooding upstream. Flooding from backwater effects may also occur as the streams discharge into the Carson River. In the past, flood damage along the Carson River has been restricted to loss of agricultural lands, destruction of bridges and irrigation works, and damage to flood plain industries such as mills (Reference 1). In addition, portions of the now-abandoned townsite of Empire have been flooded regularly by the Carson River.

Carson City is affected by floods arising from three causes: dry mantle, wet mantle, and snowmelt combined with rainfall. The mantle refers to the saturation level of the soil. Dry-mantle floods result from localized, but intense, summer thunderstorms. Wet mantle and snowmelt combined with rainfall floods are winter or early spring occurrences. Wet mantle refers to flooding that results from rainfall on already saturated soil. The majority of floods and the greatest amount of damage have resulted from wet-mantle and snowmelt combined with rainfall conditions (Reference 1).

The first major flood to be observed and described in the Carson City watershed occurred in December 1861-January 1862. The cause was snowmelt combined with rainfall. Four other wet-mantle or snowmelt combined with rainfall floods were recorded for the Carson City watershed during the 19th century, although none was measured. Most of the damage was flooded basements and first floors, washed-out roads and bridges, and lost cropland and irrigation works. Unpaved east-west streets in Carson City that carried the flows were severely scoured and gullied by these floods. From 1900 to 1980, 17 floods occurred as a result of snowmelt combined with rainfall conditions. None of these floods were measured, but the most destructive were in March 1907, December 1937-January 1938, January 1943, and November 1950. After 1950, the paving of downtown streets reduced erosion damage, and the installation of a 48-inch storm sewer along Washington Street eliminated nuisance flooding of the north-south streets between Washington and John Streets. However, total flood damage did not decrease because of new development along Mountain Street north of Washington Street (Reference 1).

Flooding along the Carson River overlaps but does not duplicate flooding from the Carson City watershed. This variability results from different sizes of drainage area and separate locations of headwaters. In addition to the 19th century floods mentioned above, the Carson River flooded in May-June 1890 from snowmelt after an unusually heavy winter of snow, known as the White Winter of 1889. A snowmelt combined with rainfall flood also occurred on Christmas Day in 1892.

During the 20th century, a flood not included above occurred in 1937 from snowmelt combined with rainfall. It was the largest flood on the Carson River since the beginning of the century, but no measurement was made of the flow at the gaging station at Carson City. The largest estimated flow so far in this century occurred in December 1955. The peak flow of 30,000 cubic feet per second (cfs) at the gaging station at Carson City corresponds to a flood recurrence interval of approximately 59 years. Other large floods occurred in February 1963 (21,900 cfs) and in November 1950 (15,500 cfs) (Reference 1) and are estimated to have recurrence intervals of approximately 36 and 22 years, respectively.

From January 1861 through January 1980, the Carson City area experienced 25 wet-mantle or snowmelt combined with rainfall floods, an average of one every 5 years. During that time, the area has experienced only four dry-mantle floods: July 1875, July 1913, August 1958, and July 1960. The 1875 flood was the most destructive because torrential rain fell on the logged, unprotected slopes of Ash and Kings Canyons. The floodwaters carried heavy loads of sediment, debris, and boulders to the canyon mouths, where the material was deposited. Croplands buried in this deluge have never been reclaimed (Reference 1). In 1913, several separate storms caused flooding and road damage in Kings Canyon and in Eagle Valley at Clear Creek. The 1960 storm also occurred over Kings Canyon. The 1958 storm occurred over C Hill, south of Kings Canyon Road. The hill had been burned over by wildfire 2 months before, leaving the slopes unprotected. Flows moved off the hill onto Circle Drive and Sharrow Way and into a development that was under construction at the time.

Despite the regular recurrence of flooding, no lives have yet been reported lost in the Carson City area during a flood. This may be because most flooding is shallow and carried primarily by city streets.

2.4 Flood Protection Measures

The Carson River basin, unlike many basins its size, has no existing dams or reservoirs upstream of Carson City (Reference 3). The U.S. Bureau of Reclamation has made feasibility studies, but has no immediate plans for construction of the proposed Watasheamu Dam on the East Fork of the Carson River.

Nonstructural measures have been implemented by Carson City to reduce the potential of future damage. One measure is the mapping of high-risk flood areas and special requirements in the Building Code for structures built in these areas. In another program, the city is purchasing portions of the upper Carson City watershed in order to rehabilitate and protect the vegetative cover. This program is being carried out with the assistance of Federal and State agencies.

All sections of the Carson City urban district are served by a storm drainage system. This system generally is adequate to carry only nuisance flooding and the runoff from smaller, frequent storms, but the system cannot handle flows from the watersheds to the west or overflow from the Carson River (References 4 and 5). Major floods are carried through city streets and across open space areas and do not necessarily follow the course of the lower flows.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The SCS publication, Computer Program for Project Formulation--Hydrology (Reference 6), was used in the hydrologic analysis of the Carson City watershed. The model was necessary because long-term streamflow records are lacking in the watershed. This rainfall-runoff model considers factors such as precipitation-duration-frequency data, hydrologic soil groups and land use, time of concentration, and storm type. The precipitation data were taken from National Oceanic Atmospheric Administration Atlas (Reference 7). Precipitation duration and distribution used in the model were those recommended by the SCS.

Long-term records (39 years) were available for analyzing various frequency flows for the Carson River at the Carson City gaging station (USGS No. 10311000). A log-Pearson Type III analysis was performed on the annual peaks in accordance with U.S. Water Resources Council guidelines (Reference 8).

Peak discharge-drainage area relationships for the streams studied in detail in Carson City are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

The 10-, 50-, 100-, and 500-year water-surface elevations for the detailed-study reaches of the Carson River, Clear Creek, Kings Canyon Creek, Goni Canyon Creek, Eagle Valley Creek, and Golf Course Creeks A and B were computed using the COE HEC-2 step-backwater computer program (Reference 9).

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Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Carson River 3 Miles Upstream of Lloyds Bridge (USGS No. 10311000)	876	8,420	23,800	36,000	90,400
Clear Creek Approximately 1 Mile Upstream of U.S. Highway 395 (in Douglas County, Nevada)	16	190	1,200	2,450	11,300
Golf Course Creeks A and B At U.S. Highway 50	5	330	1,185	1,930	5,555
Kings Canyon Creek Near Canyon Drive	5	160	765	1,390	5,065
Goni Canyon Creek At Carson City Airport	6	150	780	1,465	5,730
Eagle Valley Creek Near the Intersection of U.S. Highway 395 and Graves Lane	1	75	280	470	1,410
Ash Canyon Creek Near Longview Way	6	220	950	1,660	5,550
Vicee Canyon Creek At Confluence With Ash Canyon Creek	2	45	250	475	1,950
Combs Canyon Creek At U.S. Highway 395	3	95	425	760	2,640
Voltaire Canyon Creek Near U.S. Highway 395	2	85	390	690	2,410

The 100-year shallow flooding (average depths less than 3 feet) from Eagle Valley Creek, Eagle Extension, F Tributary, H Tributary, Voltaire Canyon Creek, Voltaire Split, and Saliman Road Tributary was analyzed using the HEC-2 program (Reference 9). Shallow flooding from the combined flow of Ash and Kings Canyon Creeks was studied using normal-depth calculations.

Alluvial fan methodologies were applied to calculate flow depths and velocities in portions of Combs Canyon, Vicee Canyon, Kings Canyon, and Ash Canyon Creeks (Reference 10). Alluvial fans are characterized by unstable channel systems due to slope and soil conditions. Consequently, flows rarely spread evenly over the surface of an alluvial fan and can be concentrated in an identifiable temporary channel or confined to only portions of the fan surface. The ability to scour and deposit sediment makes flow paths prone to lateral migration and relocation to any portion of the fan during a single runoff event and subsequent events. This erratic, unpredictable behavior subjects all portions of the fan to potential flood hazard, regardless of location. As the fan widens, the probability of flooding at a given depth and velocity at a specific point generally decreases.

The 100-year flooding in the upper portions of Clear Creek, Kings Canyon Creek, Ash Canyon Creek, Vicee Canyon Creek, Combs Canyon Creek, and Goni Canyon Creek, as well as the entire study reaches of G Tributary, Kings Split, and Channels C and D, was evaluated using the HEC-2 program (Reference 9) and is shown as approximate flooding. Due to the unpredictable nature of several of the stream channel locations, a Profile Base Line used for horizontal control was developed for the analysis.

The base line and channel and flood plain geometry was obtained using aerial photogrammetry. Aerial reconnaissance for this study was performed by Cooper Aerial Survey on November 16, 1980 (Reference 11).

Digitized cross sections, accurate to ± 1 foot, were also provided by Cooper Aerial Survey. Topographic mapping was compiled at a scale of 1:4,800, with a contour interval of 4 feet (Reference 12).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

For those stream segments studied by shallow flooding, alluvial fan, or limited-detailed study methods, no profiles are shown.

Dimensions of major drainage structures were obtained by the study contractor during field reconnaissance in October 1980. Underwater sections in the Carson River were obtained by determining flow depths at existing gaging stations and applying these average depths to adjacent stream reaches.

Roughness factors (Manning's "n") used in the hydraulic computations were estimated using Open Channel Hydraulics as a guide (Reference 13). The ranges of coefficients for the streams studied in detail are shown in Table 2.

Starting water-surface elevations were calculated using the slope-area method.

The 100-year flood elevations for the approximate-study reaches were estimated using normal-depth calculations.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail or limited detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Reference 12).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Table 2. Manning's "n" Values

Stream	Roughness Coefficients	
	Main Channel	Overbank
Kings Canyon Creek	0.025 - 0.060	0.025 - 0.060
Ash Canyon Creek	0.040 - 0.055	0.040 - 0.055
Vicee Canyon Creek	0.040 - 0.050	0.040 - 0.050
Combs Canyon Creek	0.040 - 0.060	0.040 - 0.060
Goni Canyon Creek	0.025 - 0.060	0.025 - 0.060
Voltaire Canyon Creek	0.035 - 0.060	0.035 - 0.060
Clear Creek	0.030 - 0.055	0.030 - 0.060
Golf Course Creeks A and B	0.025 - 0.050	0.025 - 0.062
Carson River	0.030	0.035
Eagle Valley Creek	0.040 - 0.050	0.045 - 0.050
H Tributary	0.035 - 0.055	0.035 - 0.055
Saliman Road Tributary	0.025 - 0.055	0.050 - 0.055

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown and was developed from normal-depth calculations and USGS topographic maps (Reference 14).

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

Floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

In areas of shallow and alluvial fan flooding, floodways were not determined because the unpredictable flow paths make delineation of a floodway meeting FEMA criteria impossible. In addition, no floodway was determined for those streams with a limited-detailed or shallow flooding analysis. Therefore, the streams for which no floodways have been delineated are portions of Clear Creek, Kings Canyon Creek, Goni Canyon Creek, Eagle Valley Creek and the entire reaches for Ash Canyon Creek, Vicee Canyon Creek, Combs Canyon Creek, H Tributary, Voltaire Canyon Creek, Voltaire Split, Saliman Road Tributary, Eagle Extension, and F Tributary. However, the community should regulate development in swales and identifiable stream channels because of historical evidence of flow in such areas.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Carson River								
A	0	266	2,763	13.0	4,579.5	4,579.5	4,580.5	1.0
B	1,140	162	1,921	18.7	4,586.8	4,586.8	4,586.9	0.1
C	2,845	144	2,195	16.4	4,595.1	4,595.1	4,595.1	0.0
D	4,045	170	3,441	10.5	4,599.6	4,599.6	4,599.7	0.1
E	4,455	340	5,987	6.0	4,600.5	4,600.5	4,601.2	0.7
F	4,565	225	5,235	6.9	4,600.6	4,600.6	4,601.3	0.7
G	4,645	375	7,460	4.8	4,601.1	4,601.1	4,601.6	0.5
H	5,005	700	13,135	2.7	4,601.4	4,601.4	4,602.0	0.6
I	6,185	500	8,876	4.1	4,601.4	4,601.4	4,602.0	0.6
J	7,225	960	16,469	2.2	4,601.5	4,601.5	4,602.3	0.8
K	10,375	2,501	37,726	1.0	4,601.7	4,601.7	4,602.5	0.8
L	11,475	2,765	37,158	1.0	4,601.7	4,601.7	4,602.5	0.8
M	13,195	2,342	28,053	1.3	4,601.7	4,601.7	4,602.5	0.8
N	14,835	1,215	13,130	2.7	4,601.7	4,601.7	4,602.5	0.8
O	16,680	1,253	11,609	3.1	4,602.0	4,602.0	4,602.8	0.8
P	18,060	1,314	10,623	3.4	4,602.4	4,602.4	4,603.3	0.9
Q	19,620	3,392	20,277	1.8	4,602.8	4,602.8	4,603.7	0.9
R	20,760	3,421	18,706	1.9	4,603.0	4,603.0	4,603.9	0.9
S	21,990	3,223	14,848	2.4	4,603.2	4,603.2	4,604.1	0.9
T	23,410	2,238	6,035	6.0	4,604.6	4,604.6	4,604.9	0.3
U	24,575	1,212	5,671	6.3	4,607.0	4,607.0	4,607.3	0.3
V	25,020	1,104	3,756	9.1	4,609.1	4,609.1	4,609.1	0.0
W	25,050	1,050	3,665	9.8	4,609.1	4,609.1	4,609.1	0.0
X	26,815	445	4,814	7.5	4,612.5	4,612.5	4,613.3	0.8
Y	28,845	185	2,449	14.7	4,614.5	4,614.5	4,615.1	0.6
Z	30,380	180	2,995	12.0	4,618.4	4,618.4	4,619.4	1.0
AA	32,130	188	2,427	14.8	4,621.8	4,621.8	4,622.8	1.0

[1] Feet Above Downstream Limit of Detailed Study

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOODWAY DATA

CARSON RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Clear Creek								
A	400	282	433	6.6	4,633.4	4,633.4	4,634.4	1.0
B	3,560	213	559	5.1	4,657.8	4,657.8	4,658.8	1.0
C	6,060	140	368	7.8	4,674.2	4,674.2	4,675.1	0.9
D	6,960	85	271	10.1	4,685.8	4,685.8	4,686.4	0.6
E	8,460	132	429	6.4	4,700.6	4,700.6	4,701.2	0.6
F	10,430	323[2]	576	4.7	4,715.2	4,715.2	4,715.2	0.0
G	10,460	276[2]	934	2.9	4,716.3	4,716.3	4,716.3	0.0
H	12,610	215	357	7.5	4,739.5	4,739.5	4,739.8	0.3
I	13,660	182	549	4.9	4,747.9	4,747.9	4,748.7	0.8
J	13,945	66	245	10.9	4,755.2	4,755.2	4,755.2	0.0
K	14,065	108	747	3.6	4,761.8	4,761.8	4,762.5	0.7
L	15,265	123/50[3]	338	7.9	4,769.9	4,769.9	4,770.3	0.4
M	16,045	333[2]	493	5.4	4,778.8	4,778.8	4,778.8	0.0
N	16,135	350[2]	2,468	1.1	4,783.5	4,783.5	4,783.6	0.1

[1] Feet Above Downstream Limit of Detailed Study [2] Floodway Lies Entirely Outside Corporate Limits

[3] Width/Width Within Corporate Limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOODWAY DATA

CLEAR CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Golf Course Creek A								
A	80[1]	1,471	5,609	0.3	4,616.2	4,616.2	4,616.9	0.7
B	750[1]	125	133	5.9	4,620.0	4,620.0	4,620.6	0.6
C	1,530[1]	120	198	3.9	4,635.0	4,635.0	4,635.8	0.8
Golf Course Creek B								
A	1,240[2]	543	342	5.6	4,605.4	4,605.4	4,606.1	0.7
B	1,950[2]	864	952	2.0	4,612.2	4,612.2	4,612.9	0.7
C	2,110[2]	1,471	4,531	0.4	4,616.2	4,616.2	4,616.2	0.0
D	2,580[2]	170	190	6.1	4,616.4	4,616.4	4,616.5	0.1
E	3,960[2]	130	310	3.7	4,631.0	4,631.0	4,631.9	0.9

[1] Feet Above U.S. Highway 50 [2] Feet Above Confluence With Carson River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOODWAY DATA

GOLF COURSE CREEK A-GOLF COURSE CREEK B

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Kings Canyon Creek								
A	4,600	1,173	1,963	6.6	4,604.0	4,604.0	4,605.0	1.0
B	5,840	333	2,047	6.4	4,614.9	4,614.9	4,615.7	0.8
C	5,955	338	1,565	8.3	4,615.3	4,615.3	4,616.0	0.7
D	6,835	650	3,582	3.6	4,619.2	4,619.2	4,619.9	0.7
E	6,905	850	5,408	2.4	4,619.3	4,619.3	4,620.1	0.8
F	7,785	790	4,172	3.1	4,619.9	4,619.9	4,620.8	0.9
G	9,255	879[2]	2,189	6.0	4,624.0	4,624.0	4,624.7	0.7
H	9,325	1,185[2]	7,123	1.8	4,625.0	4,625.0	4,626.0	1.0
I	10,325	2,650	13,814	0.9	4,625.3	4,625.3	4,626.3	1.0
J	11,795	3,635	2,025	6.4	4,627.2	4,627.2	4,627.6	0.4
K	13,645	2,430	4,374	1.4	4,639.7	4,639.7	4,640.4	0.7

[1] Feet Above Confluence With Carson River [2] Width Does Not Include Area in Island

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOODWAY DATA

KINGS CANYON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Goni Canyon Creek								
A	1,710	783	1,175	3.2	4,631.8	4,630.6[2]	4,630.8[2]	0.2
B	2,500	911	889	4.2	4,635.4	4,633.9[2]	4,634.0[2]	0.1
C	3,285	843	2,419	1.5	4,638.1	4,638.1	4,638.6	0.5
D	5,325	863	606	6.1	4,652.9	4,652.9	4,653.0	0.1
E	6,680	800	751	4.3	4,664.6	4,664.6	4,664.8	0.2
F	6,745	801	2,570	1.3	4,664.9	4,664.9	4,665.3	0.4
G	7,220	560	564	5.8	4,666.5	4,666.5	4,666.5	0.0
H	7,300	678	603	5.4	4,668.1	4,668.1	4,668.2	0.1
I	7,860	831	761	4.3	4,671.9	4,671.9	4,672.0	0.1
J	7,930	961	624	5.2	4,673.2	4,673.2	4,673.5	0.3
K	9,135	840	320	5.0	4,684.0	4,684.0	4,684.4	0.4
L	9,170	840	1,170	1.4	4,684.4	4,684.4	4,685.0	0.6
M	10,250	599	311	5.1	4,692.4	4,692.4	4,692.4	0.0
N	12,050	550	377	3.9	4,715.3	4,715.3	4,715.3	0.0
O	12,085	550	330	4.4	4,718.5	4,718.5	4,718.5	0.0
P	13,145	1,376	976	1.5	4,732.2	4,732.2	4,732.2	0.0
Q	14,465	1,710	373	3.9	4,760.4	4,760.4	4,760.4	0.0

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[1] Feet Above Downstream Limit of Detailed Study

[2] Elevations Computed Without Consideration of Influence from Kings Canyon Creek

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOODWAY DATA

GONI CANYON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Eagle Valley Creek								
A	0	51	100	4.7	4,752.9	4,752.9	4,753.9	1.0
B	700	80	87	5.4	4,763.2	4,763.2	4,763.6	0.4
C	1,045	70	87	5.4	4,771.1	4,771.1	4,771.3	0.2
D	1,780	100	88	5.4	4,789.2	4,789.2	4,789.3	0.1
E	2,070	136	97	4.9	4,800.0	4,800.0	4,800.5	0.5
F	2,370	50	78	6.0	4,807.5	4,807.5	4,808.1	0.6
G	2,720	49	69	6.8	4,818.8	4,818.8	4,818.8	0.0
H	3,715	24	55	8.6	4,878.8	4,878.8	4,878.8	0.0

[1] Feet Above Eagle Valley Ranch Road

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

TABLE 3

FLOODWAY DATA

EAGLE VALLEY CREEK

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

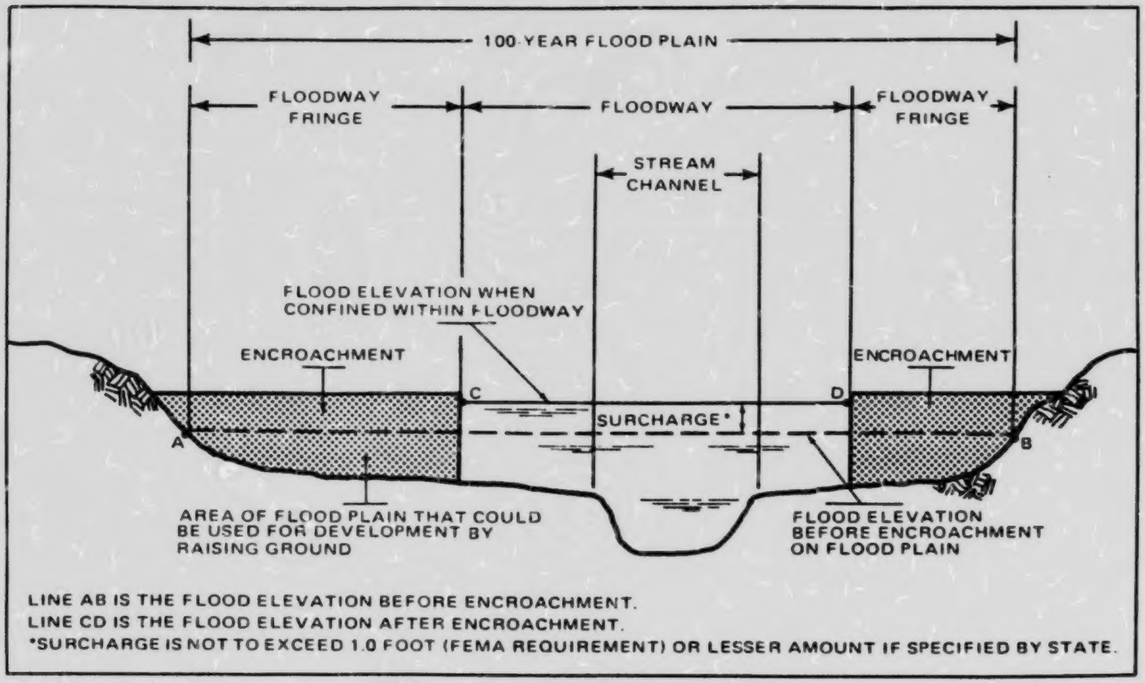
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Carson City.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Carson City are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone AO:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.
Zone AH:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Carson River							
Reach 1	0040,0045 0085,0090	-10.8	-4.4	13.8	110	A21	Varies - See Map
Reach 2	0085	-6.3	-3.4	14.3	065	A13	Varies - See Map
Reach 3	0085,0130	-3.9	-1.6	12.0	040	A8	Varies - See Map
Reach 4	0130	-6.3	-1.9	6.5	065	A13	Varies - See Map
Reach 5	0130	-8.4	-2.9	8.8	085	A17	Varies - See Map
Clear Creek							
Reach 1	0170,0175	-1.8	-0.4	1.7	020	A4	Varies - See Map
Reach 2	0170,0175	-4.3	-1.6	1.9	045	A9	Varies - See Map
Reach 3	0125,0170	-2.4	-0.8	2.4	025	A5	Varies - See Map
Golf Course Creek A							
Reach 1	0040	-0.6	-0.2	0.6	005	A1	Varies - See Map
Golf Course Creek B							
Reach 1	0040	-0.8	-0.3	0.9	010	A2	Varies - See Map

[1] Flood Insurance Rate Map Panel

[2] Weighted Average

[3] Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOOD INSURANCE ZONE DATA

CARSON RIVER-CLEAR CREEK-GOLF COURSE CREEK A-GOLF COURSE CREEK B

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Kings Canyon Creek							
Reach 1	0085	-2.9	-1.0	2.9	030	A6	Varies - See Map
Reach 2	0085	-0.9	-0.3	1.1	010	A2	Varies - See Map
Alluvial Fan Flooding	0080	N/A	N/A	N/A	N/A	A0	Depth 1[4]
Alluvial Fan Flooding	0080	N/A	N/A	N/A	N/A	A0	Depth 2[4]
Goni Canyon Creek							
Reach 1	0040,0085	-1.1	-0.4	1.0	010	A2	Varies - See Map
Eagle Valley Creek							
Reach 1	0035	-1.0	-0.3	0.9	010	A2	Varies - See Map
Shallow Flooding	0035	N/A	N/A	N/A	N/A	AH	Varies - See Map
Ash Canyon Creek							
Alluvial Fan Flooding	0080	N/A	N/A	N/A	N/A	A0	Depth 1[4]
Alluvial Fan Flooding	0080	N/A	N/A	N/A	N/A	A0	Depth 2[4]
Vicee Canyon Creek							
Alluvial Fan Flooding	0035	N/A	N/A	N/A	N/A	A0	Depth 1[4]
Combs Canyon Creek							
Shallow Flooding	0035	N/A	N/A	N/A	N/A	AH	Varies - See Map
Alluvial Fan Flooding	0035	N/A	N/A	N/A	N/A	A0	Depth 1[4]
Alluvial Fan Flooding	0035	N/A	N/A	N/A	N/A	A0	Depth 2, Velocity 6

[1] Flood Insurance Rate Map Panel [2] Weighted Average [3] Rounded to Nearest Foot [4] See Map for Velocities

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOOD INSURANCE ZONE DATA

KINGS CANYON CREEK-GONI CANYON CREEK-EAGLE VALLEY CREEK-
ASH CANYON CREEK-VICEE CANYON CREEK-COMBS CANYON CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
H Tributary Shallow Flooding	0080,0085 0125	N/A	N/A	N/A	N/A	AH	Varies - See Map
Voltaire Canyon Creek Shallow Flooding	0080,0125	N/A	N/A	N/A	N/A	AH	Varies - See Map
Voltaire Split Shallow Flooding	0125	N/A	N/A	N/A	N/A	AO	Depth 1
Saliman Road Tributary Shallow Flooding	0080,0085 0130,0175	N/A	N/A	N/A	N/A	AH	Varies - See Map

[1] Flood Insurance Rate Map Panel [2] Weighted Average [3] Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOOD INSURANCE ZONE DATA

H TRIBUTARY-VOLTAIRE CANYON CREEK-VOLTAIRE SPLIT-SALIMAN ROAD TRIBUTARY

Zones A1, A2, A4, A5, A6, A8, A9, A13, A17, and A21:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.
Zone D:	Areas of undetermined, but possible flood hazard.

Alluvial fan flood hazard areas are shown on the Flood Insurance Rate Map (published separately) as Zone A0, with average depths and velocities of flow given. In these areas, depths of the 100-year flood may exceed 3 feet. Development on alluvial fans is subject to a more severe flood hazard than would normally be encountered in Zone A0 due to high velocities and the unpredictability of the location of stream channel across the width of the fan.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Carson City is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

A draft Flood Insurance Study was completed by the USGS in 1977, but was not accepted (Reference 15). Other studies have discussed the general flooding problems of Carson City in connection with development of a storm drainage master plan (References 4 and 5).

A Flood Hazard Boundary Map has been published for the City of Carson City (Reference 16). Due to the more detailed analyses used, this study supersedes the Flood Hazard Boundary Map.

Flood Insurance Studies have been prepared for the unincorporated areas of Douglas County (Reference 17), Lyon County (Reference 18), and Washoe County, Nevada (Reference 19), and Placer County, California (Reference 20). The results of this study are in general agreement with those Flood Insurance Studies.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Building 105, Presidio of San Francisco, San Francisco, California 94129.

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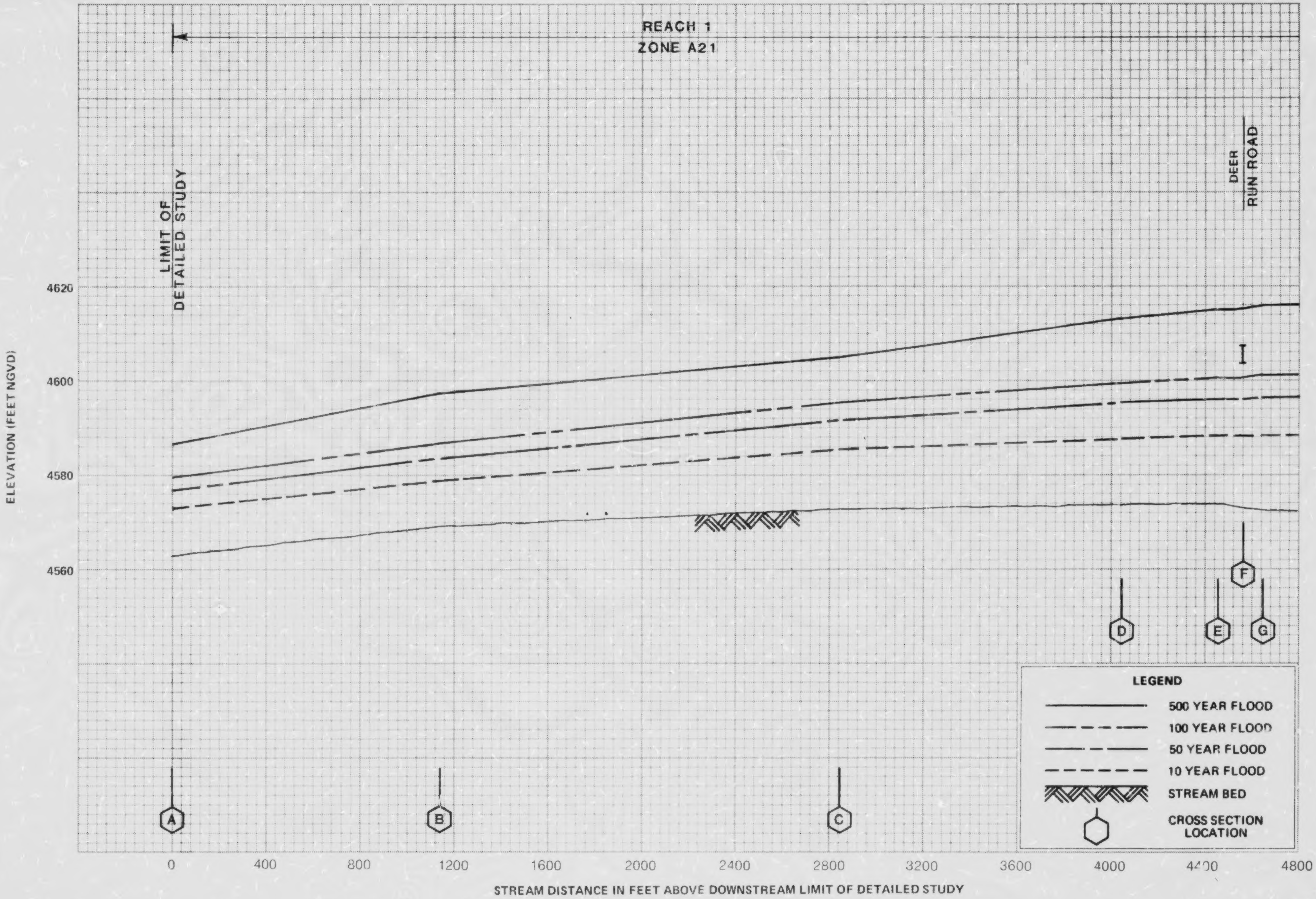

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

FLOOD PROFILE

CARSON RIVER

01P

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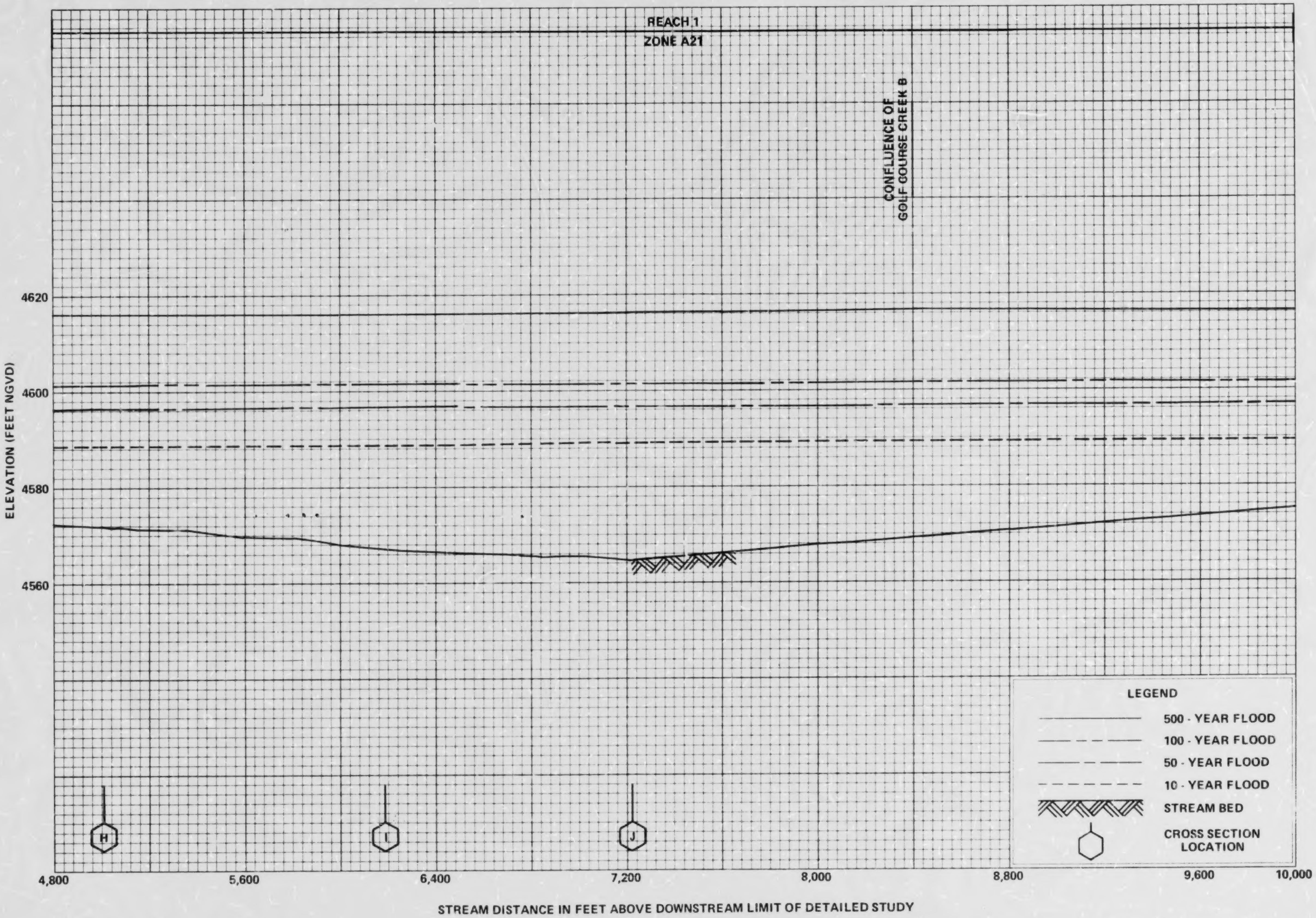


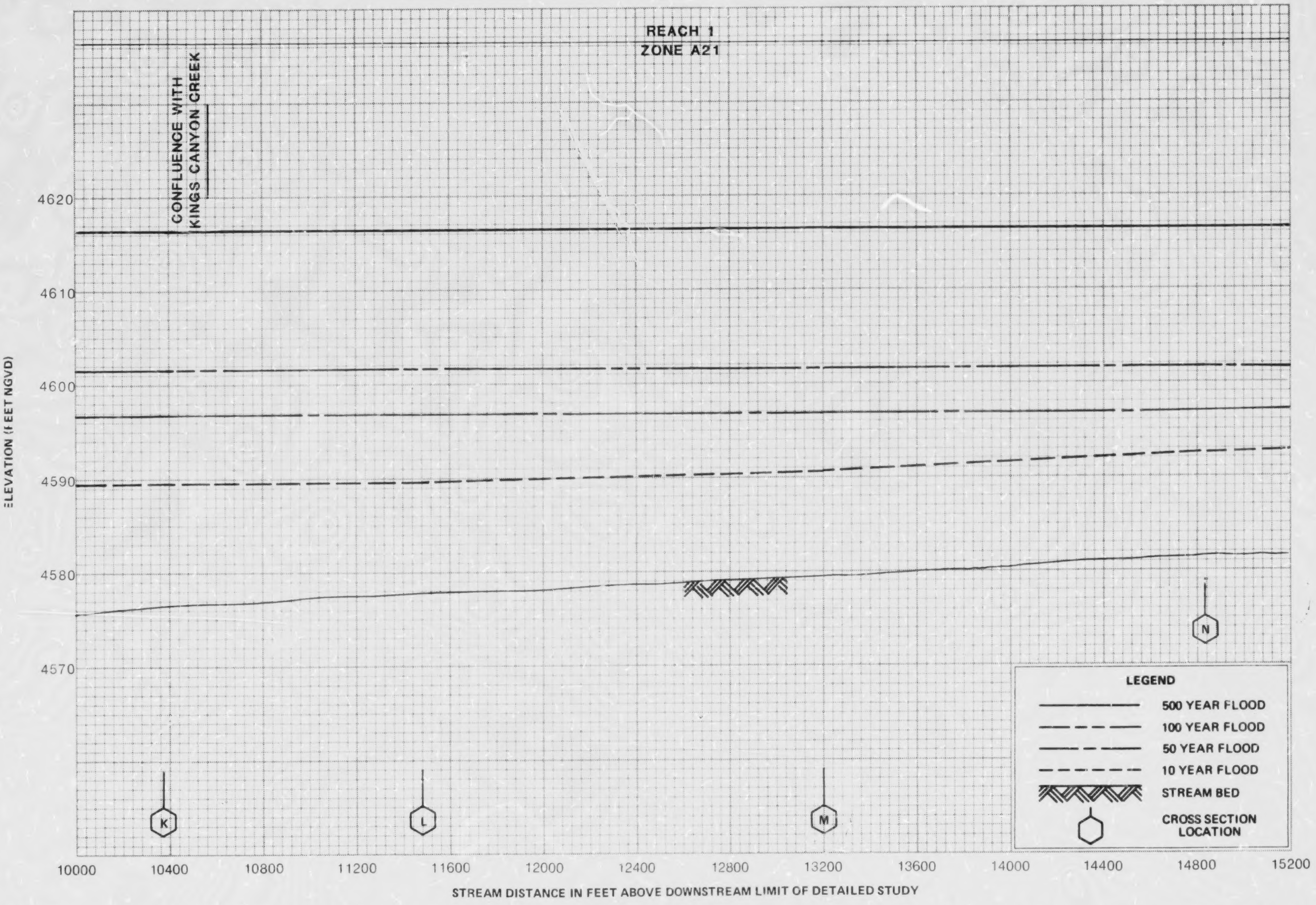
FLOOD PROFILES

CARSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

02P



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CARSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

03P

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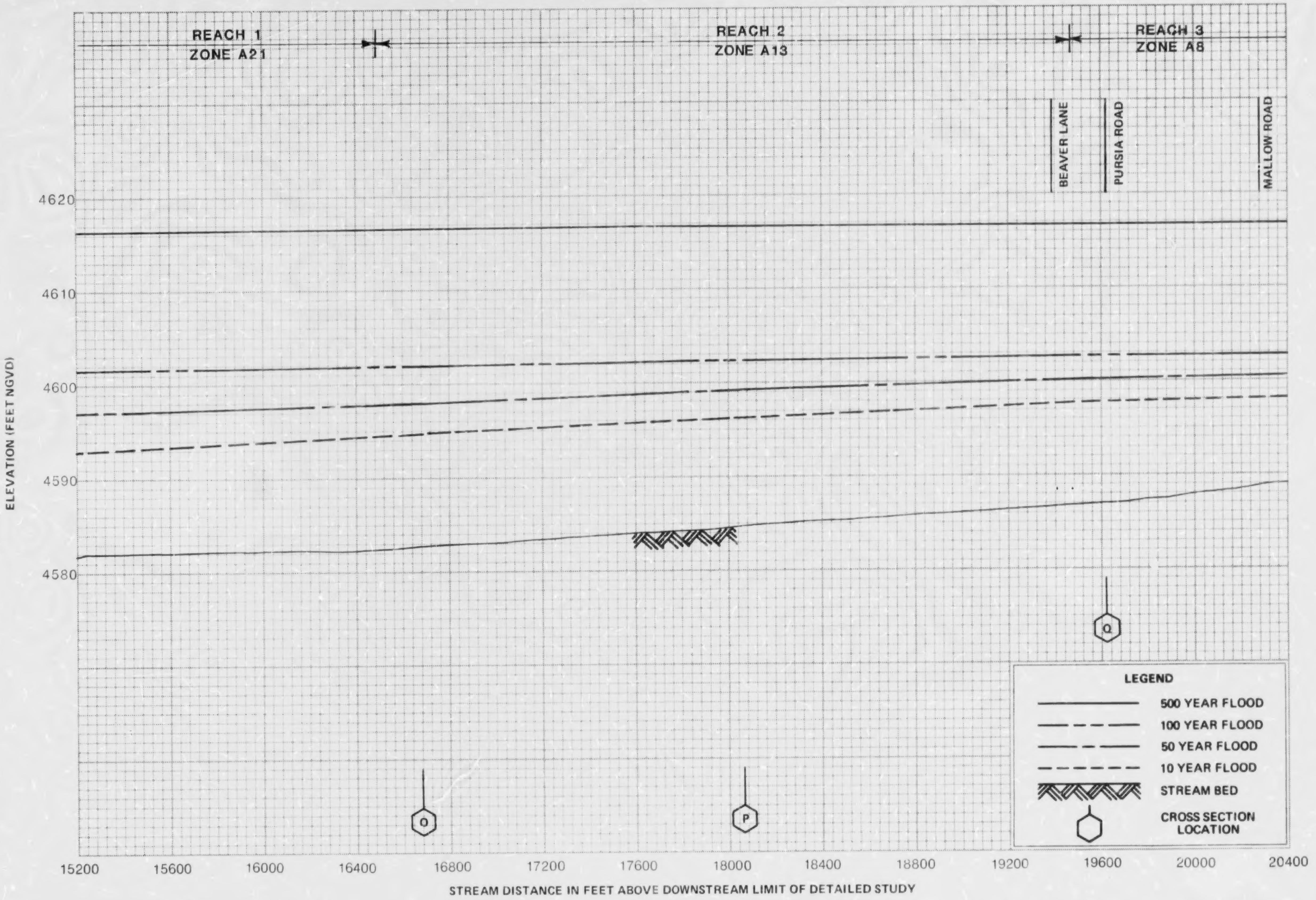


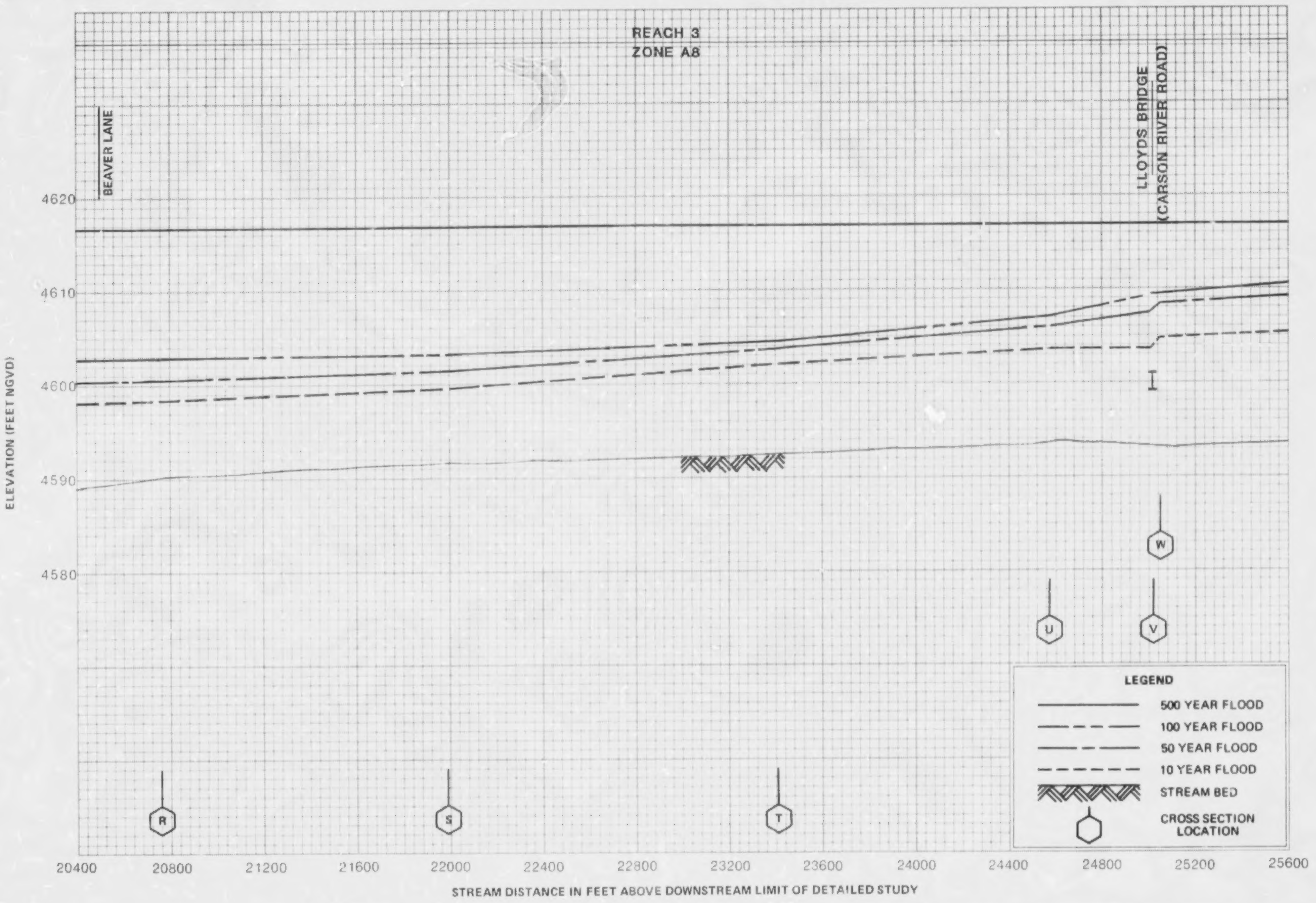
FLOOD PROFILE

CARSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

04P



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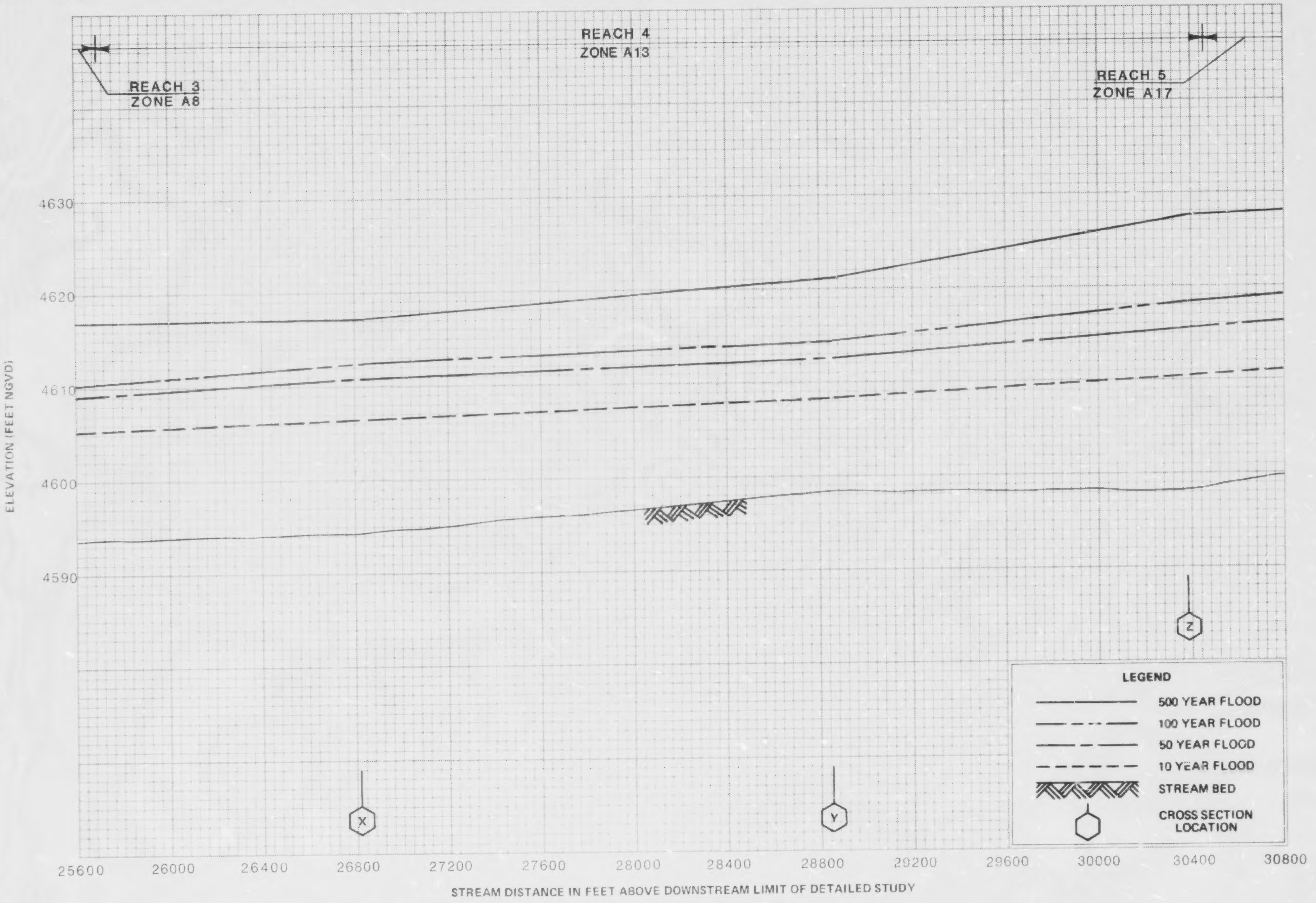
CARSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

05P



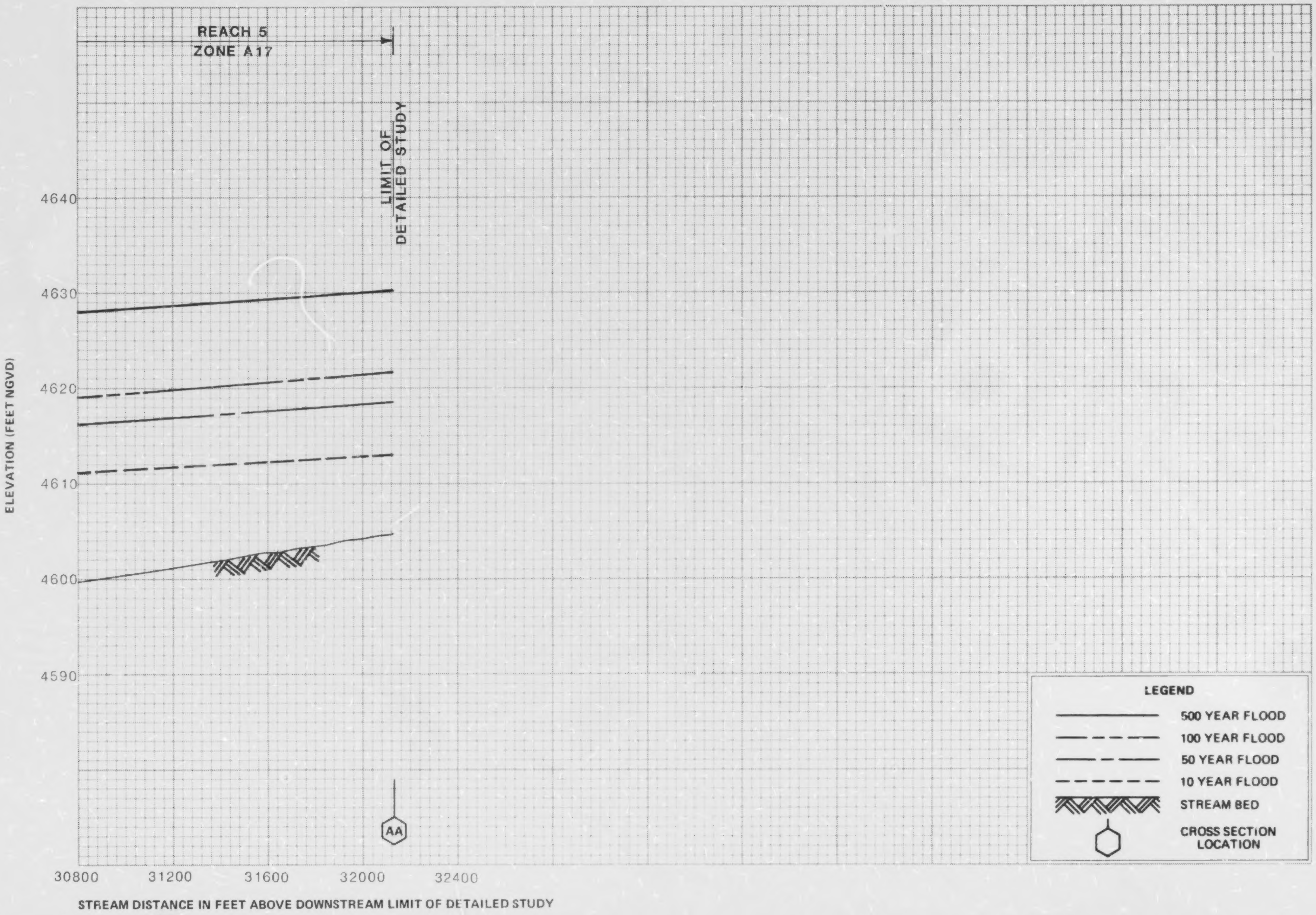
FLOOD PROFILE

CARSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

06P



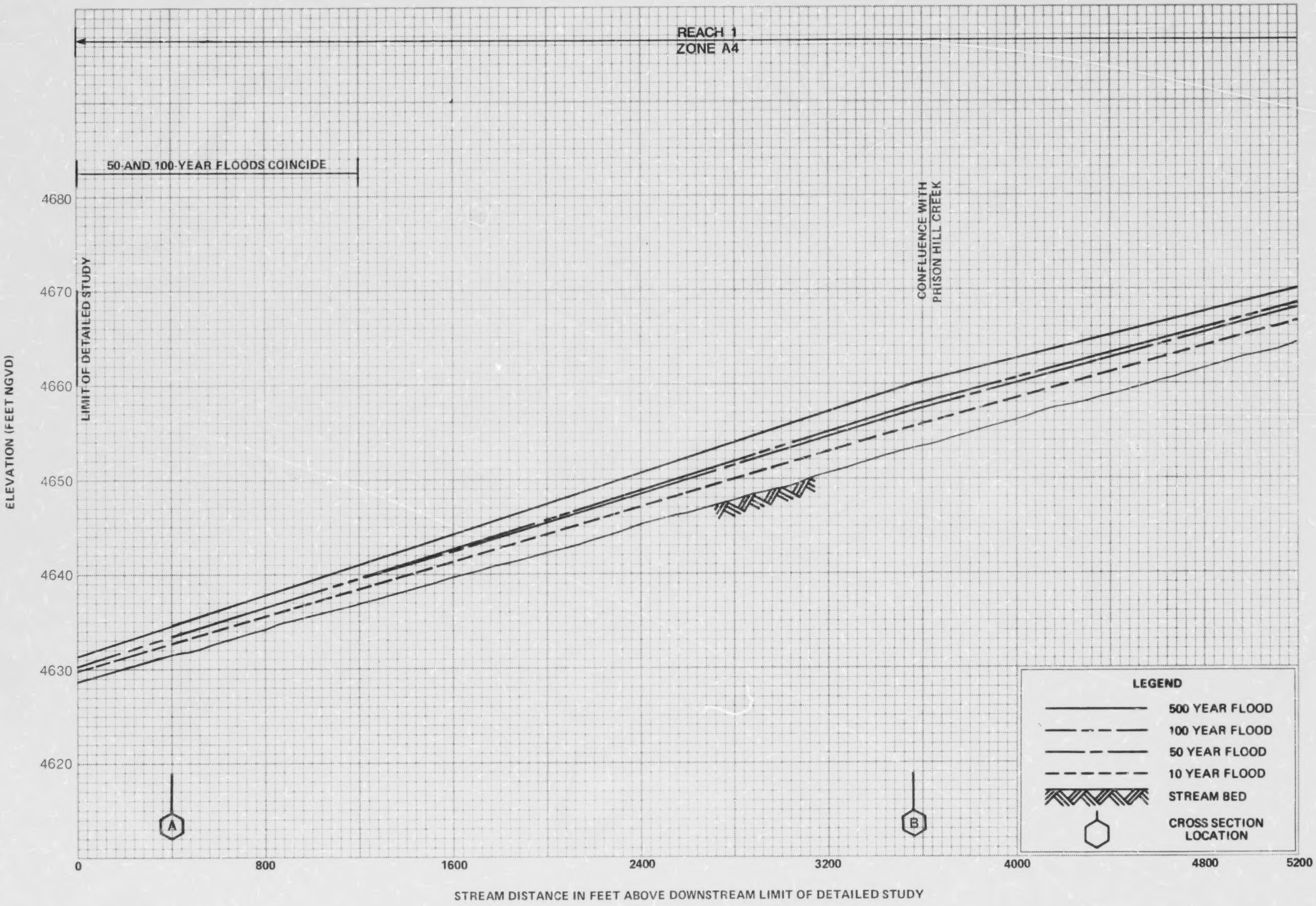
FLOOD PROFILE

CARSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

07P



FLOOD PROFILE

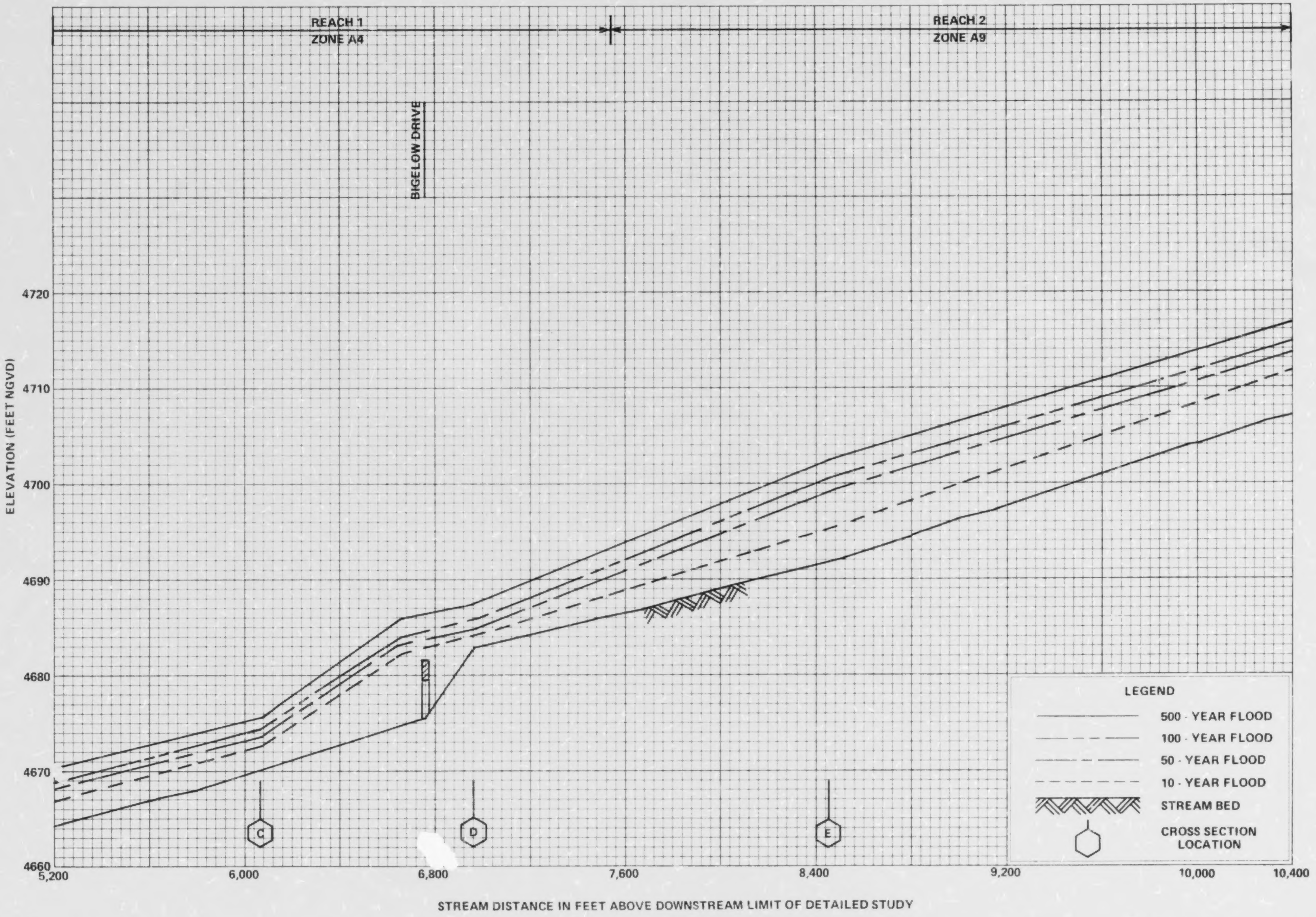
CLEAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

08P

37



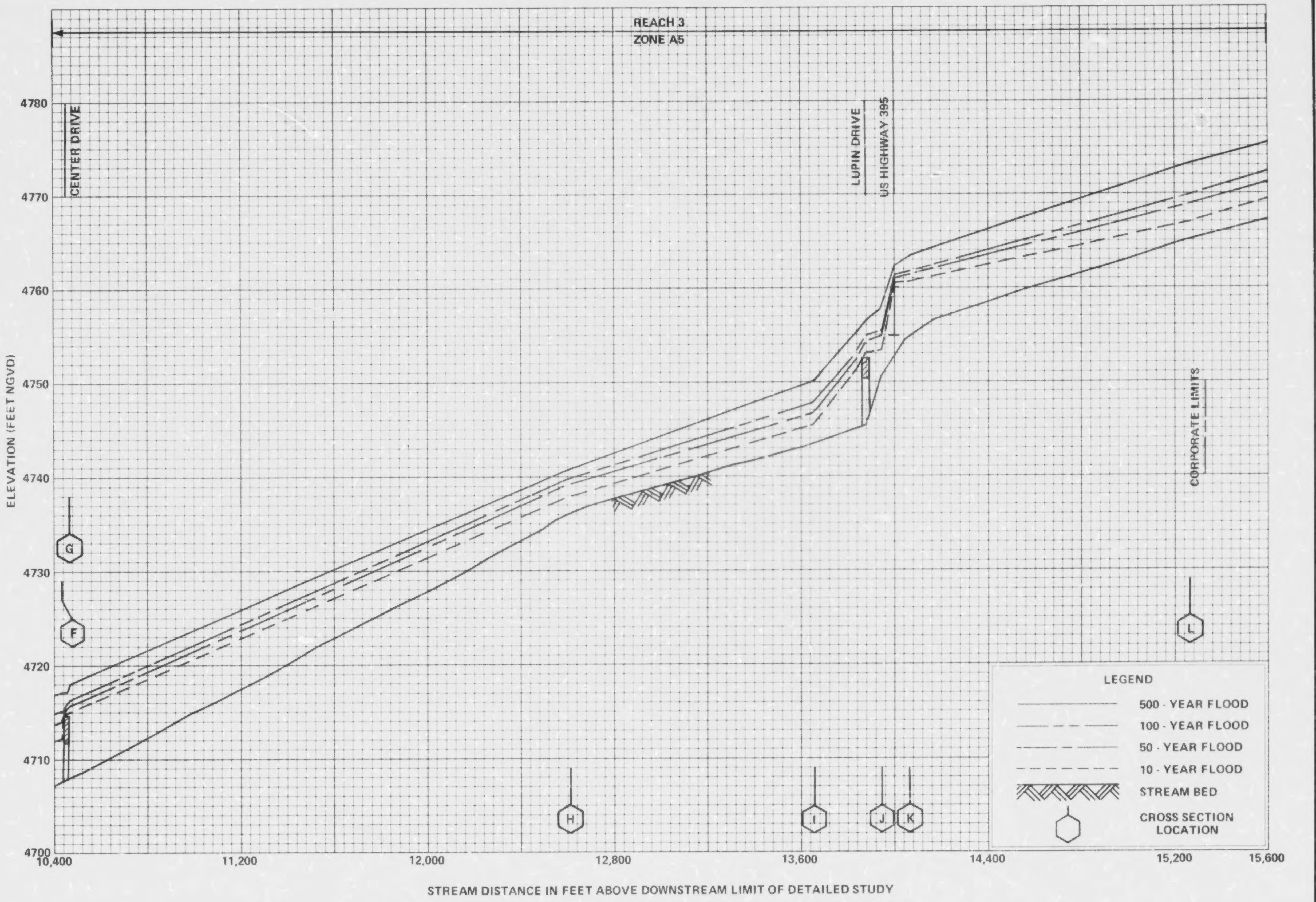
FLOOD PROFILES

CLEAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

09P



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CLEAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

10P

59

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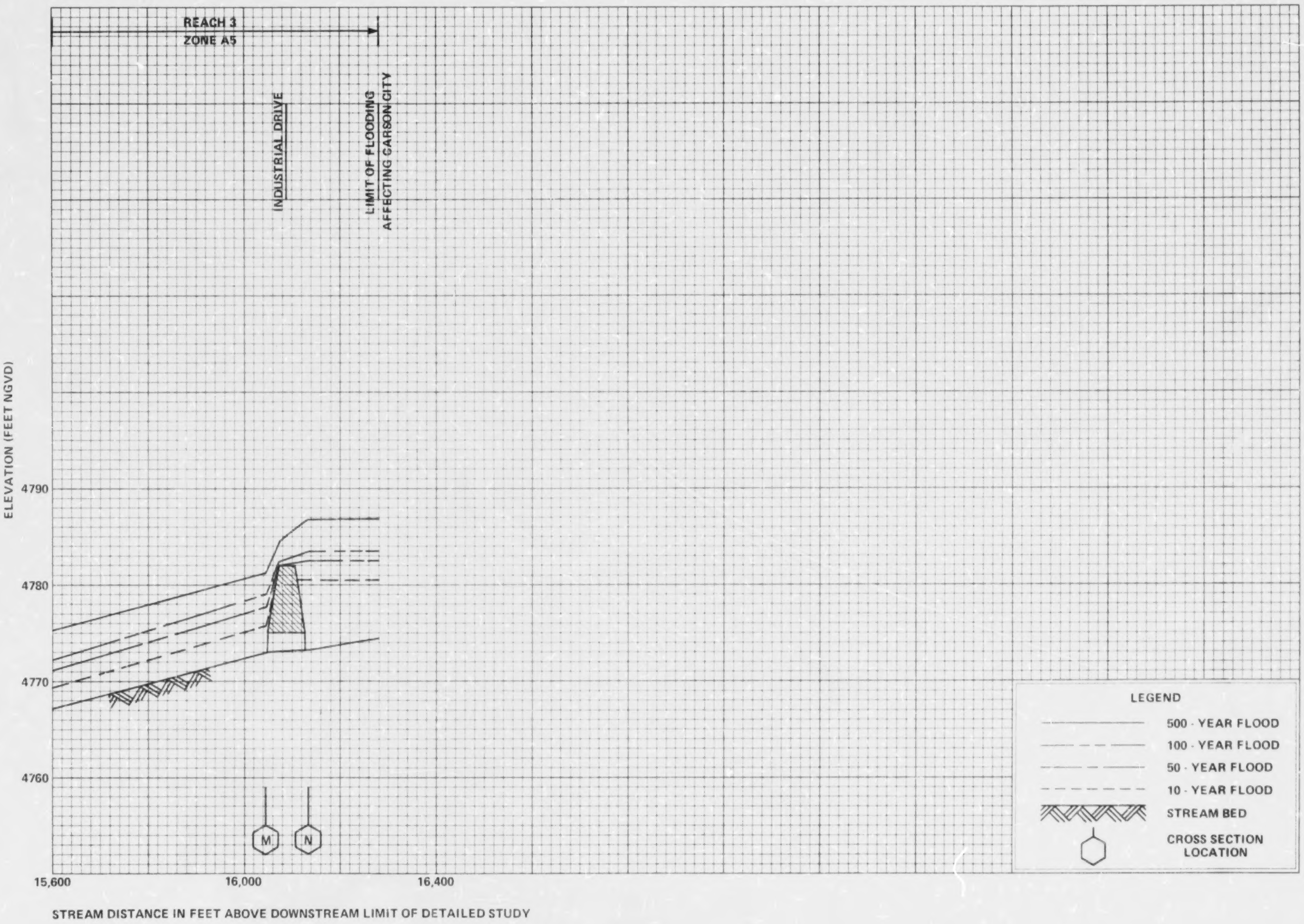


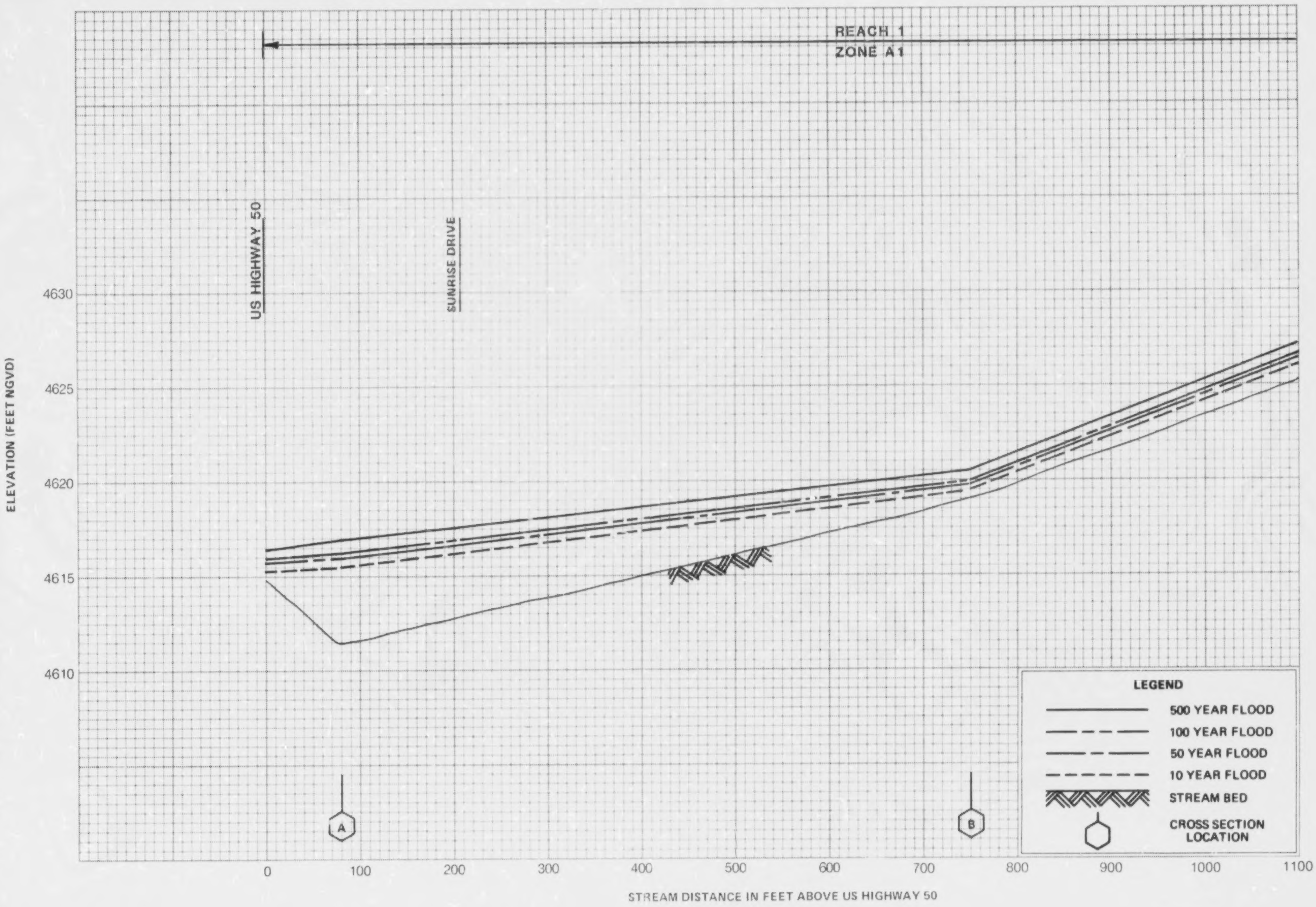
FLOOD PROFILES

CLEAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

11P



FLOOD PROFILE

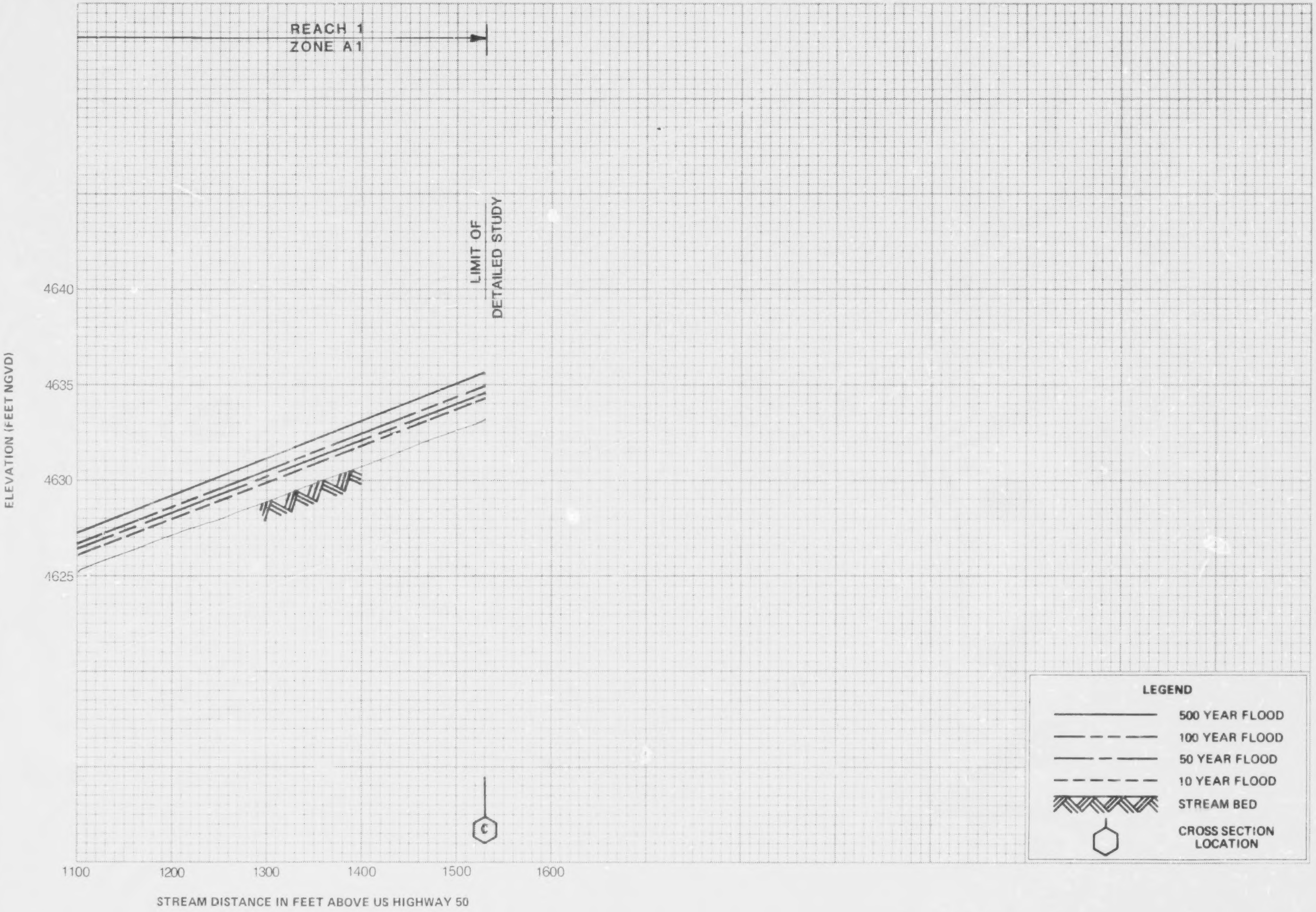
GOLF COURSE CREEK A

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

12P

41



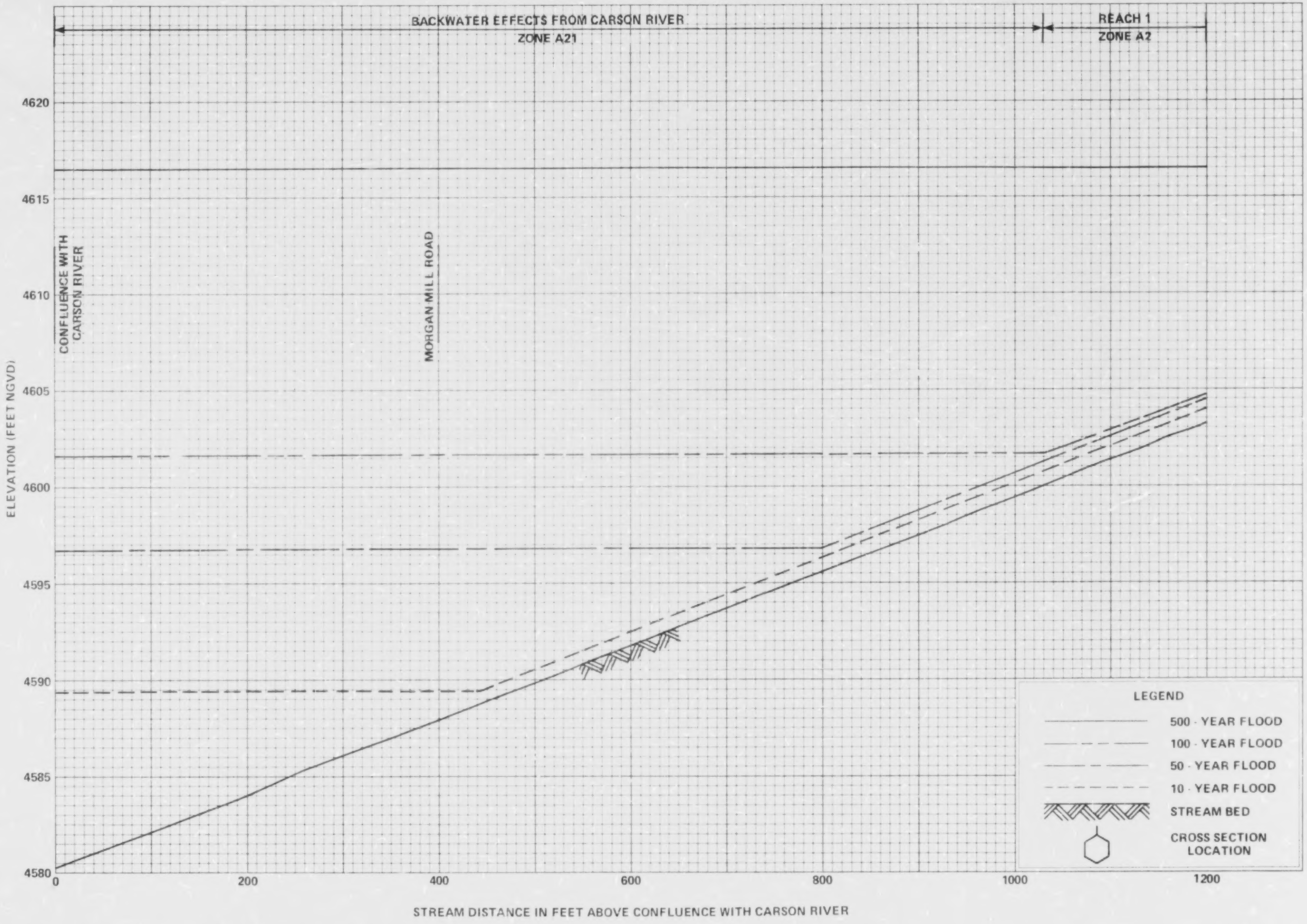
FLOOD PROFILE

GOLF COURSE CREEK A

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

13P



FLOOD PROFILES

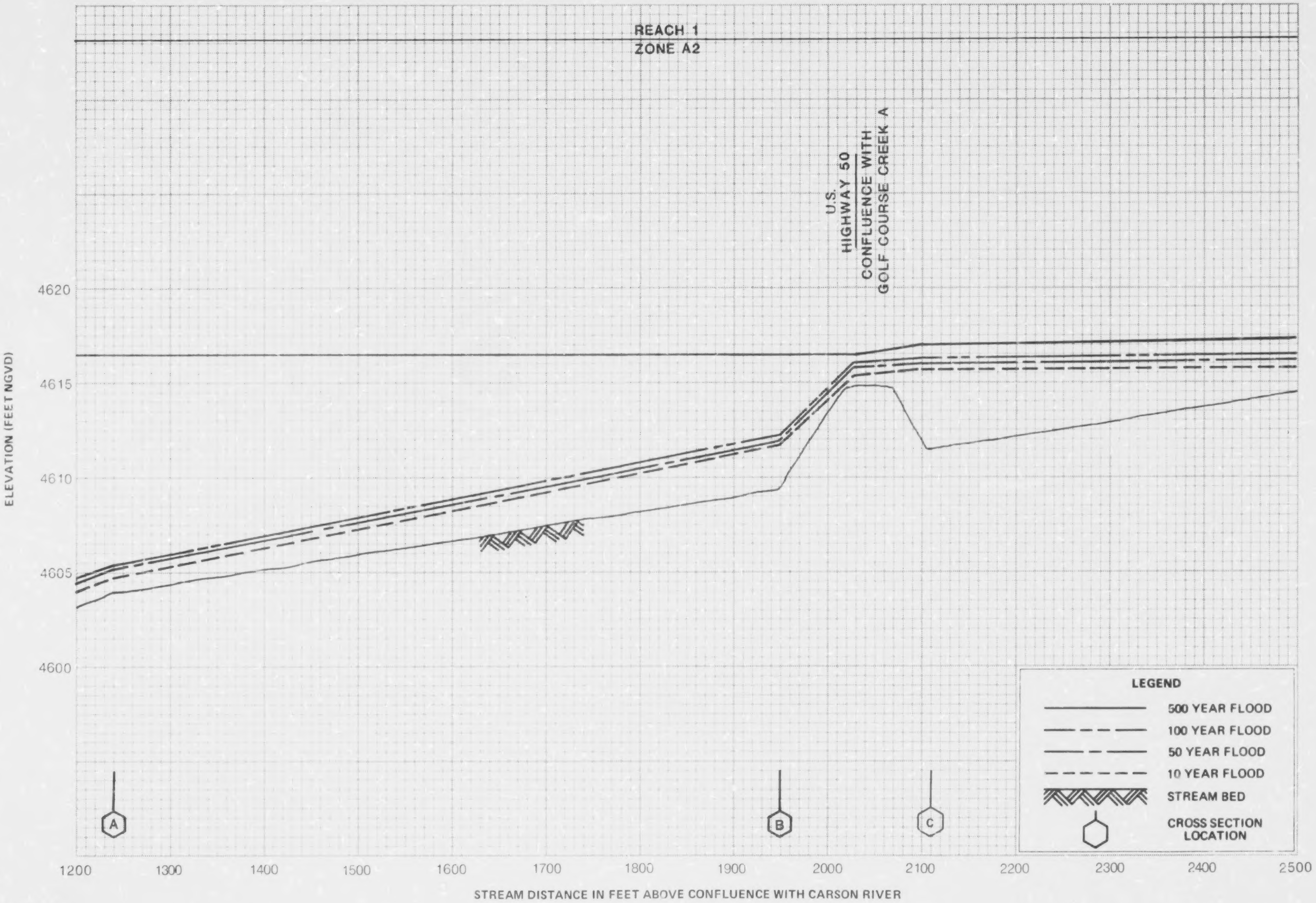
GOLF COURSE CREEK B

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

14P

43

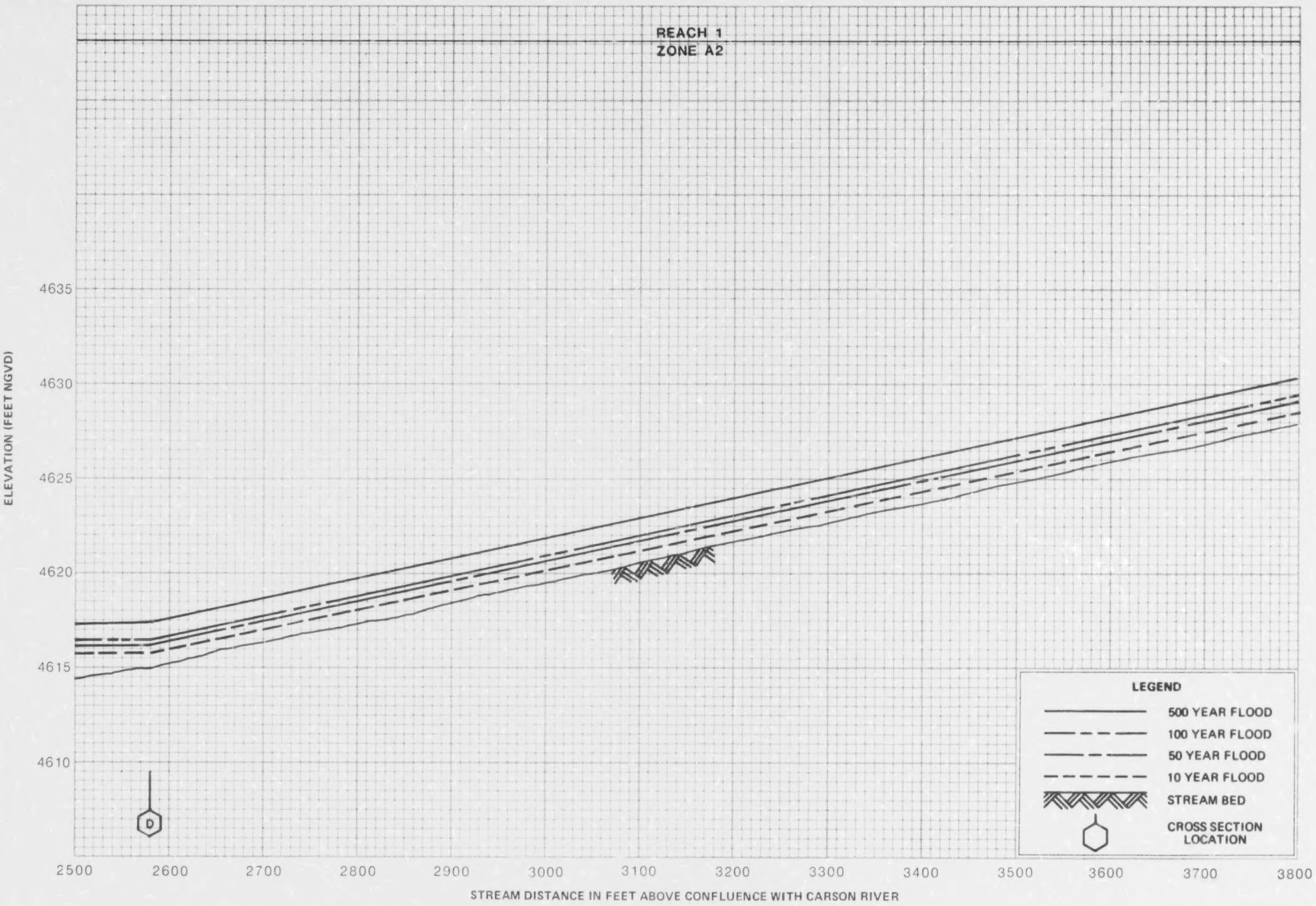


FLOOD PROFILE

GOLF COURSE CREEK B

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)



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GOLF COURSE CREEK B

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

16P

4/5

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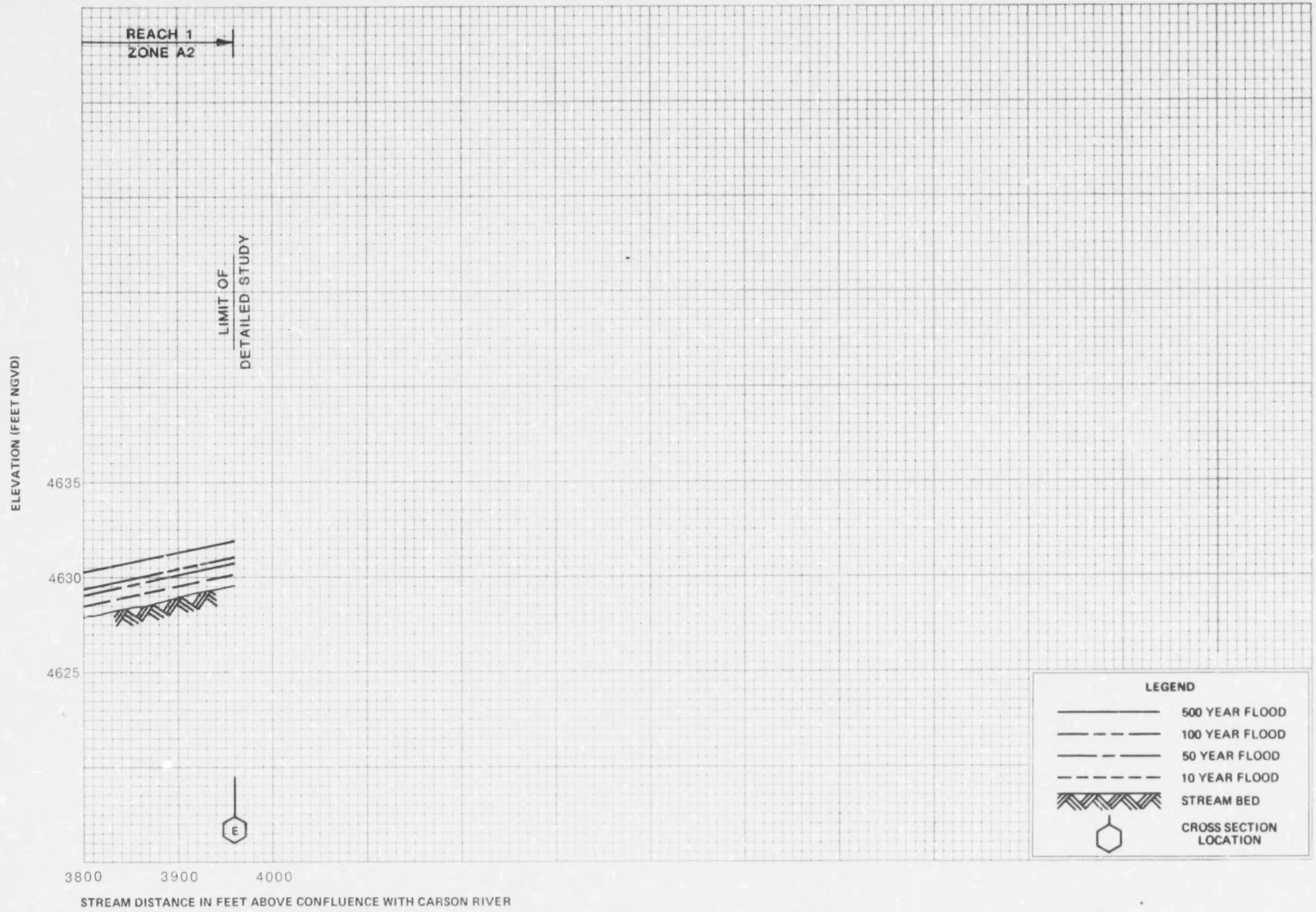


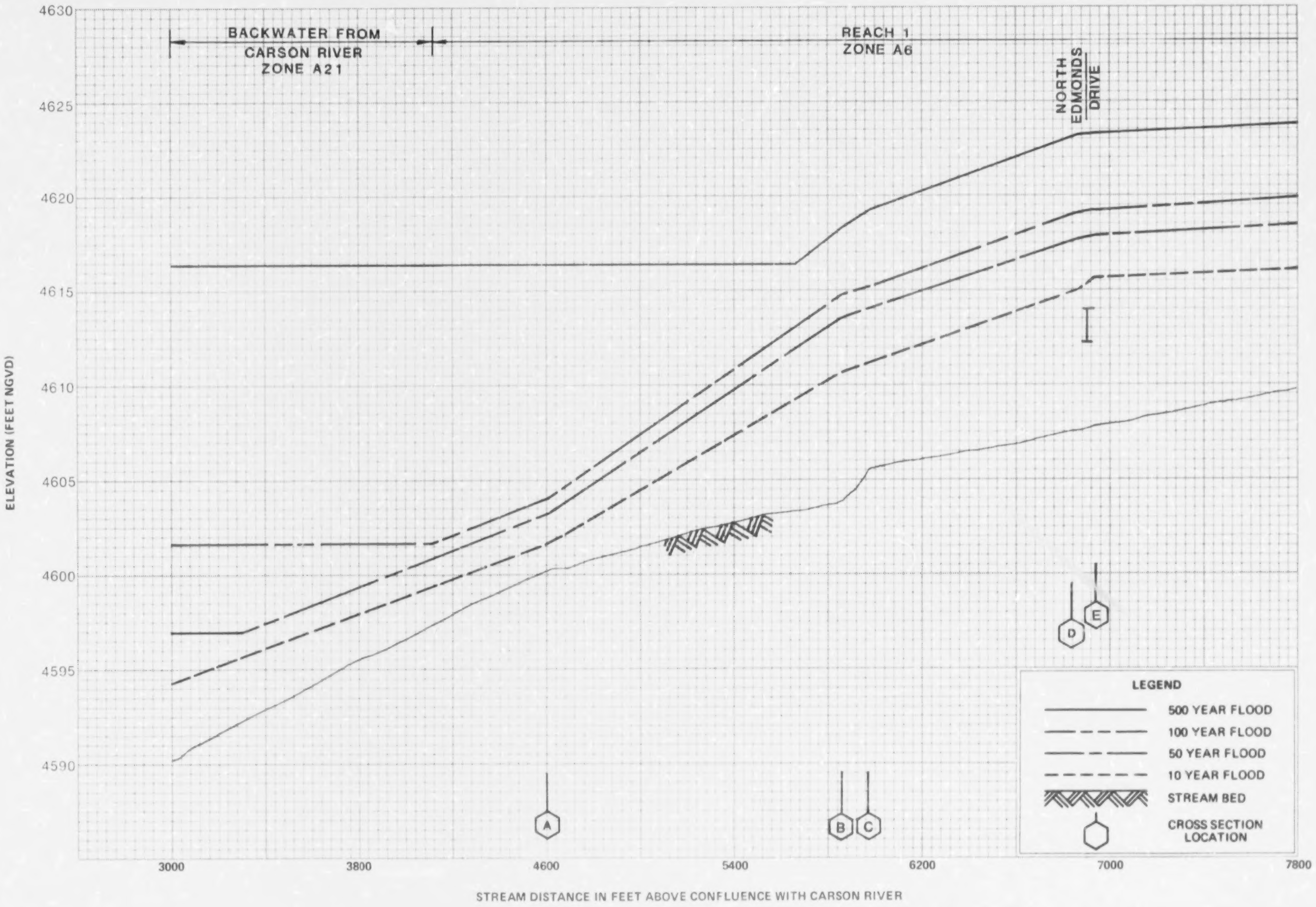
FLOOD PROFILE

GOLF COURSE CREEK B

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

17P



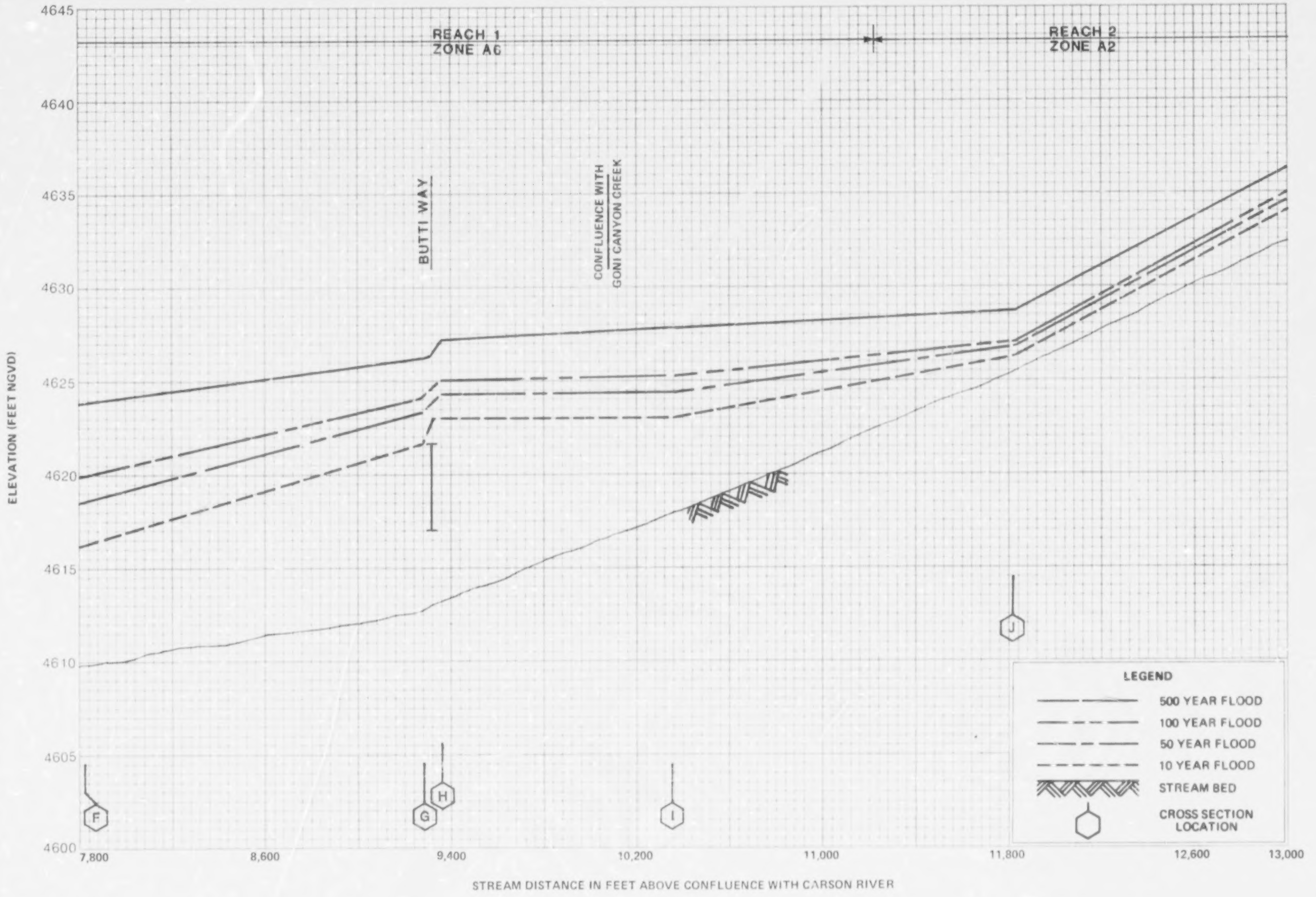
FLOOD PROFILE

KINGS CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

18P



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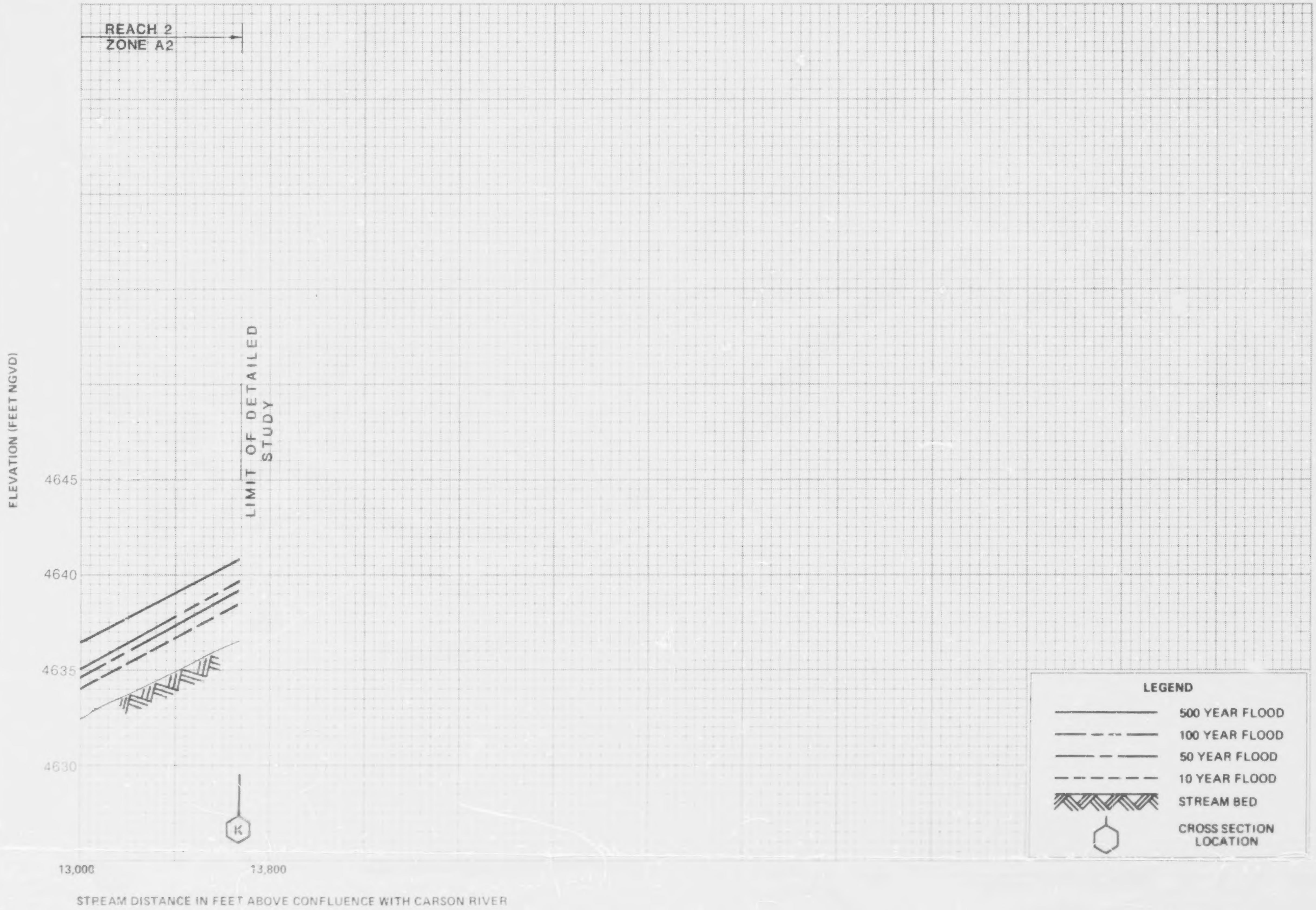
KINGS CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)



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KINGS CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

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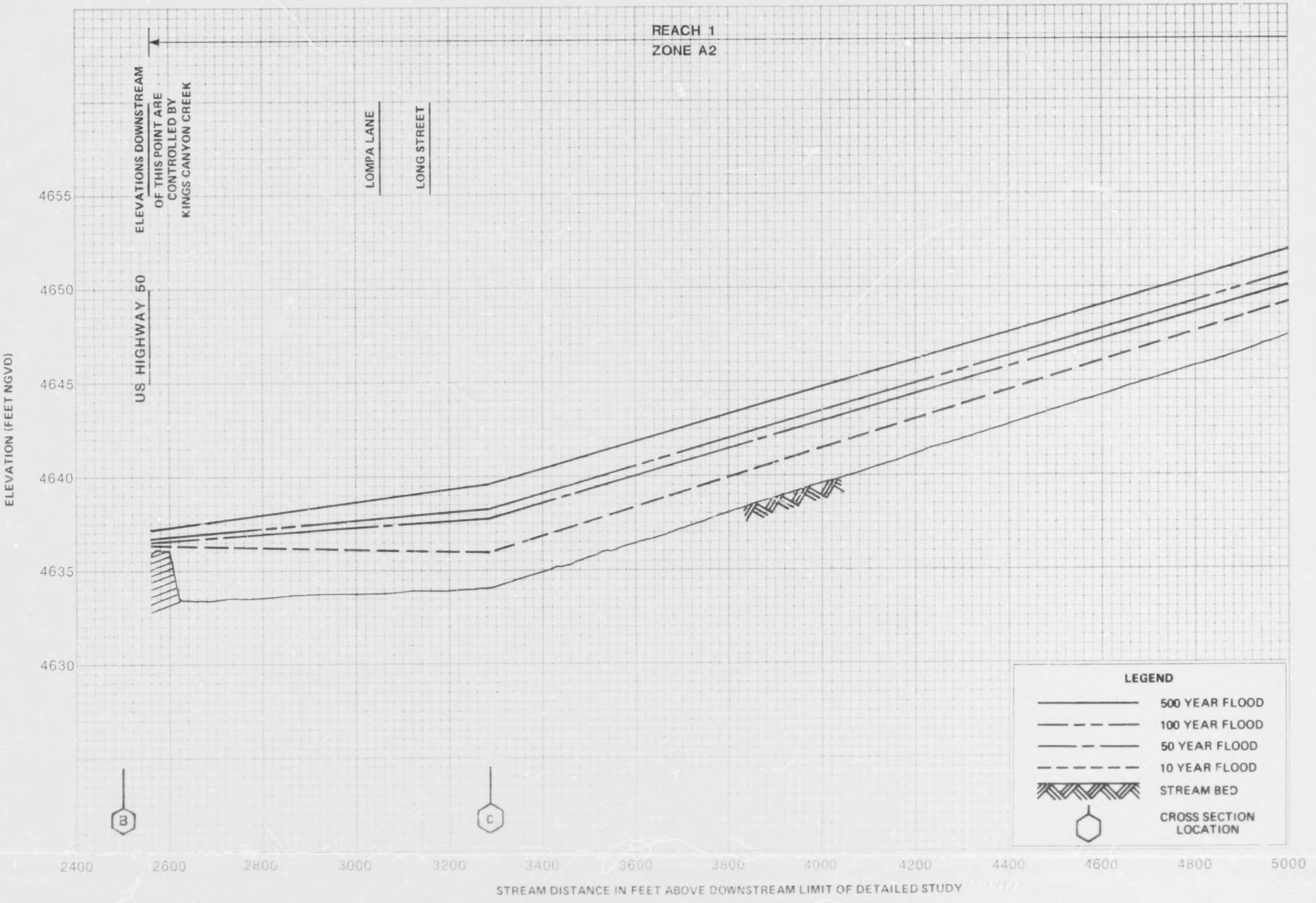

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GONI CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

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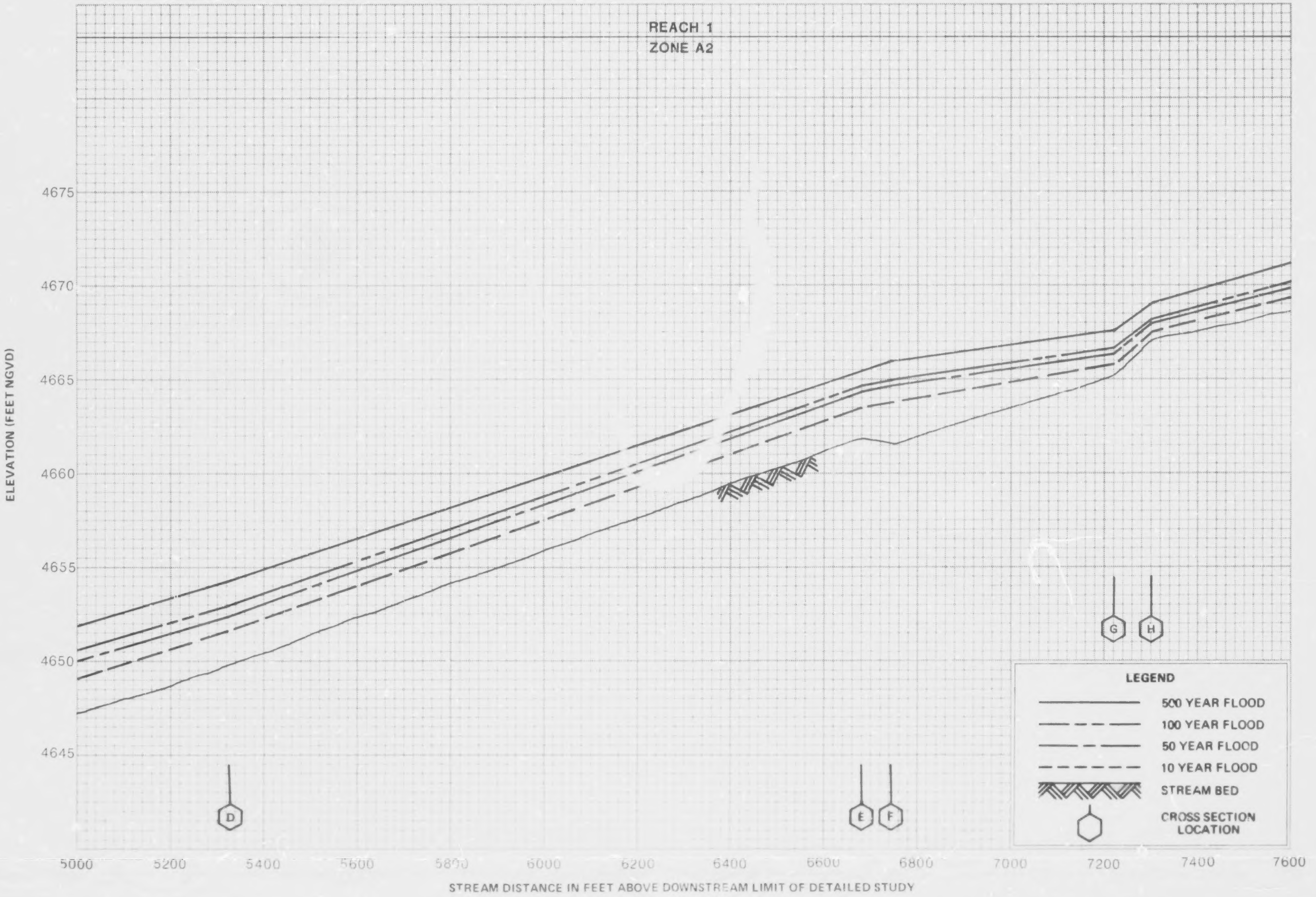

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GONI CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

56

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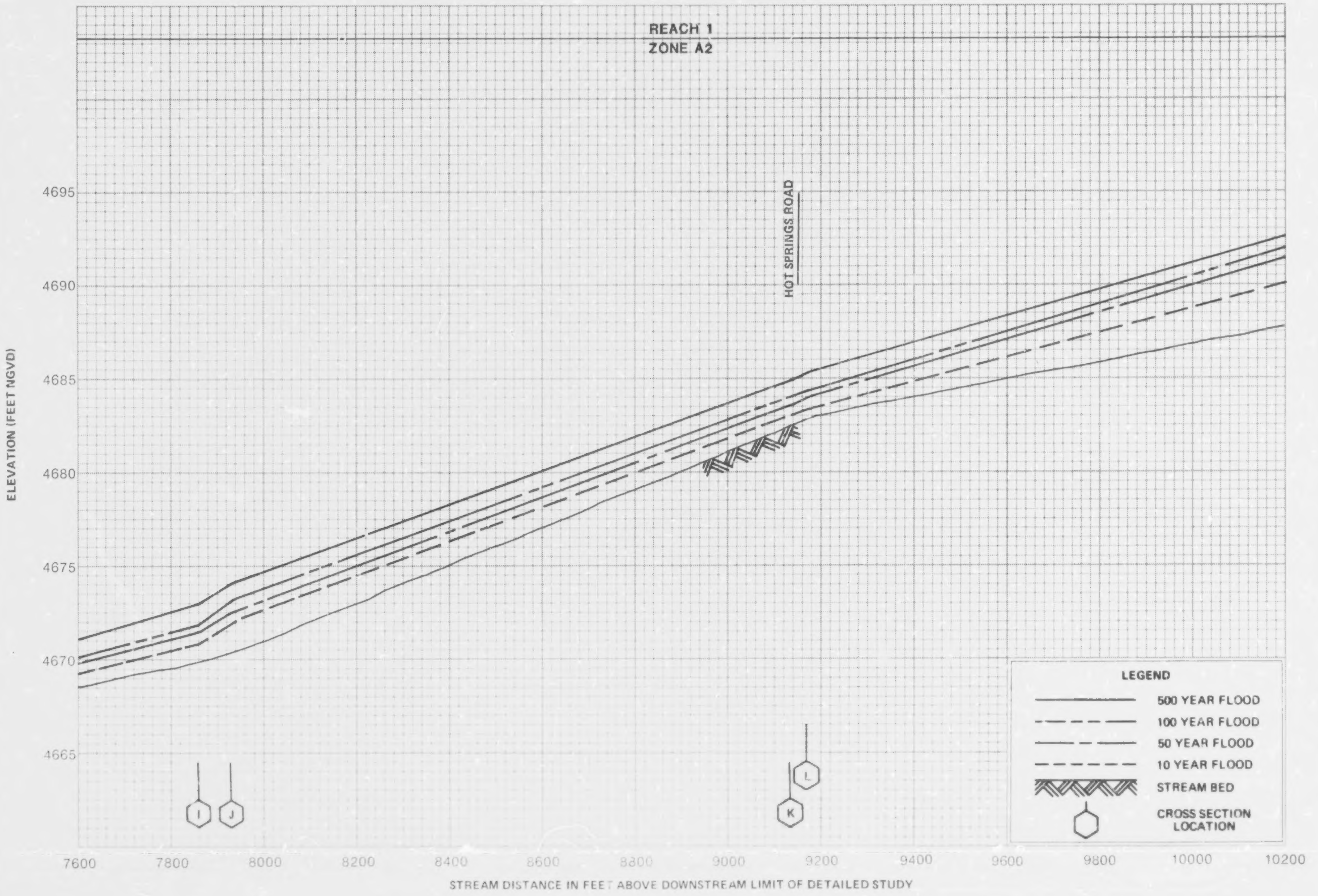

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GONI CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

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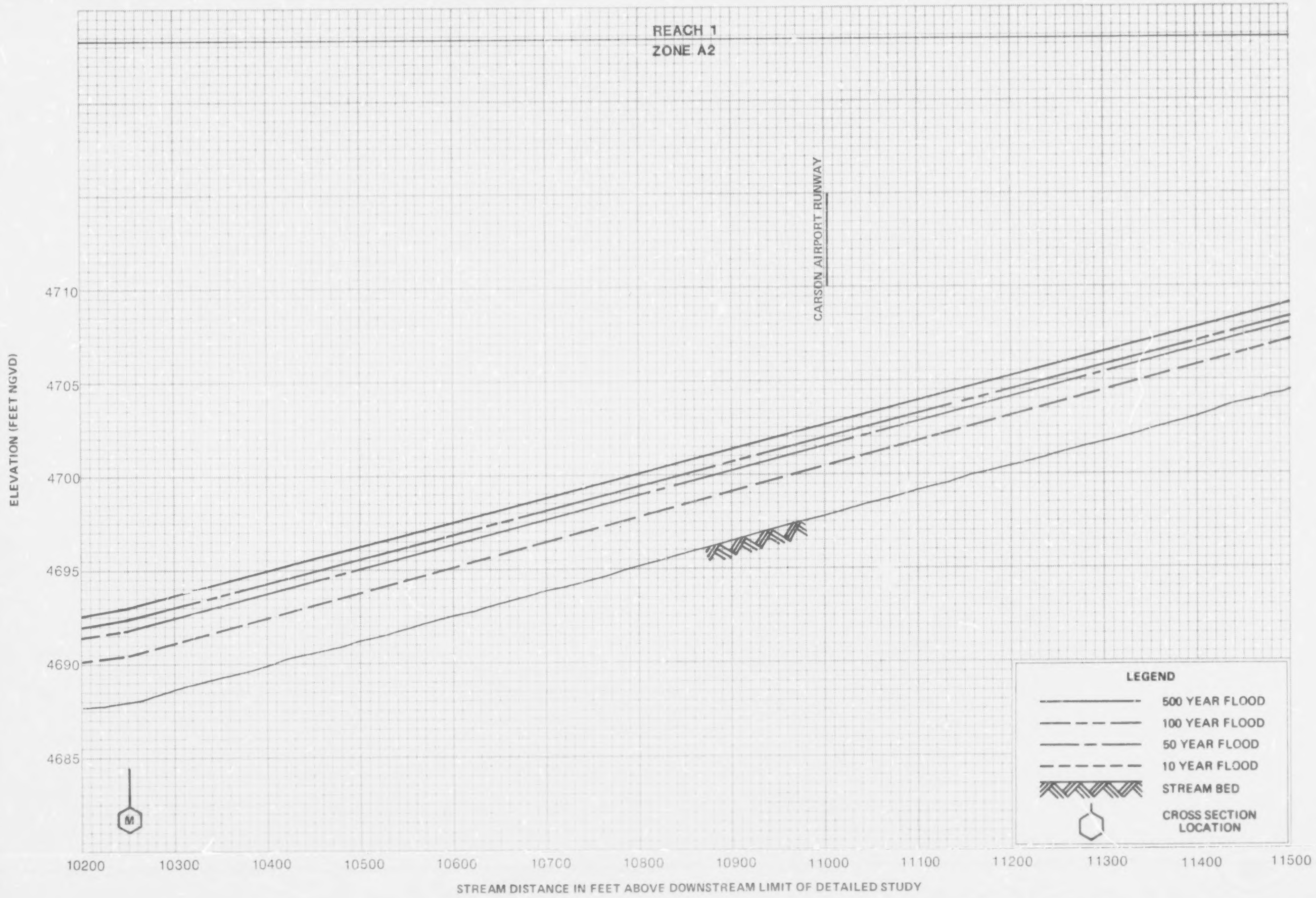

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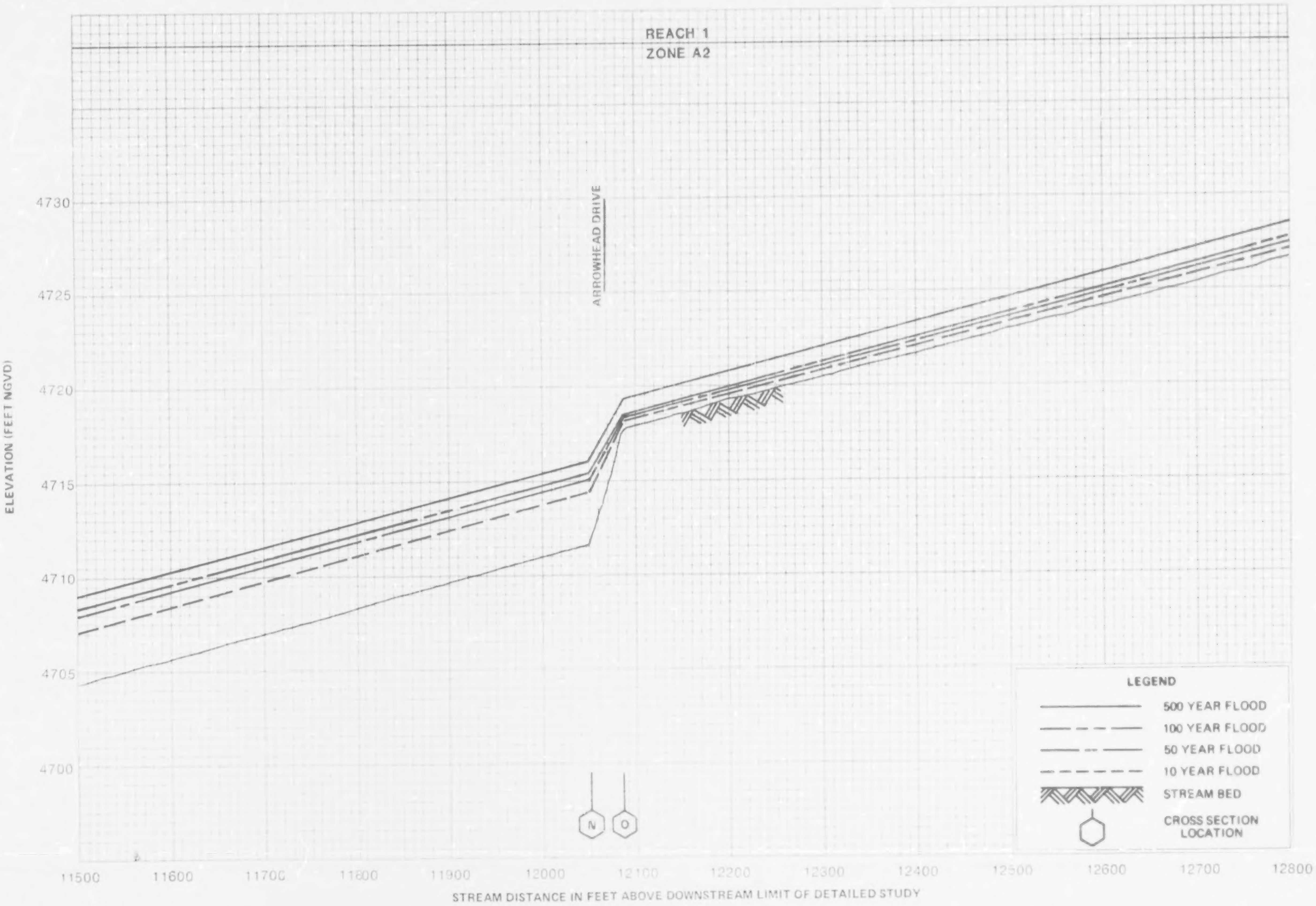
GONI CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)



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GONI CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

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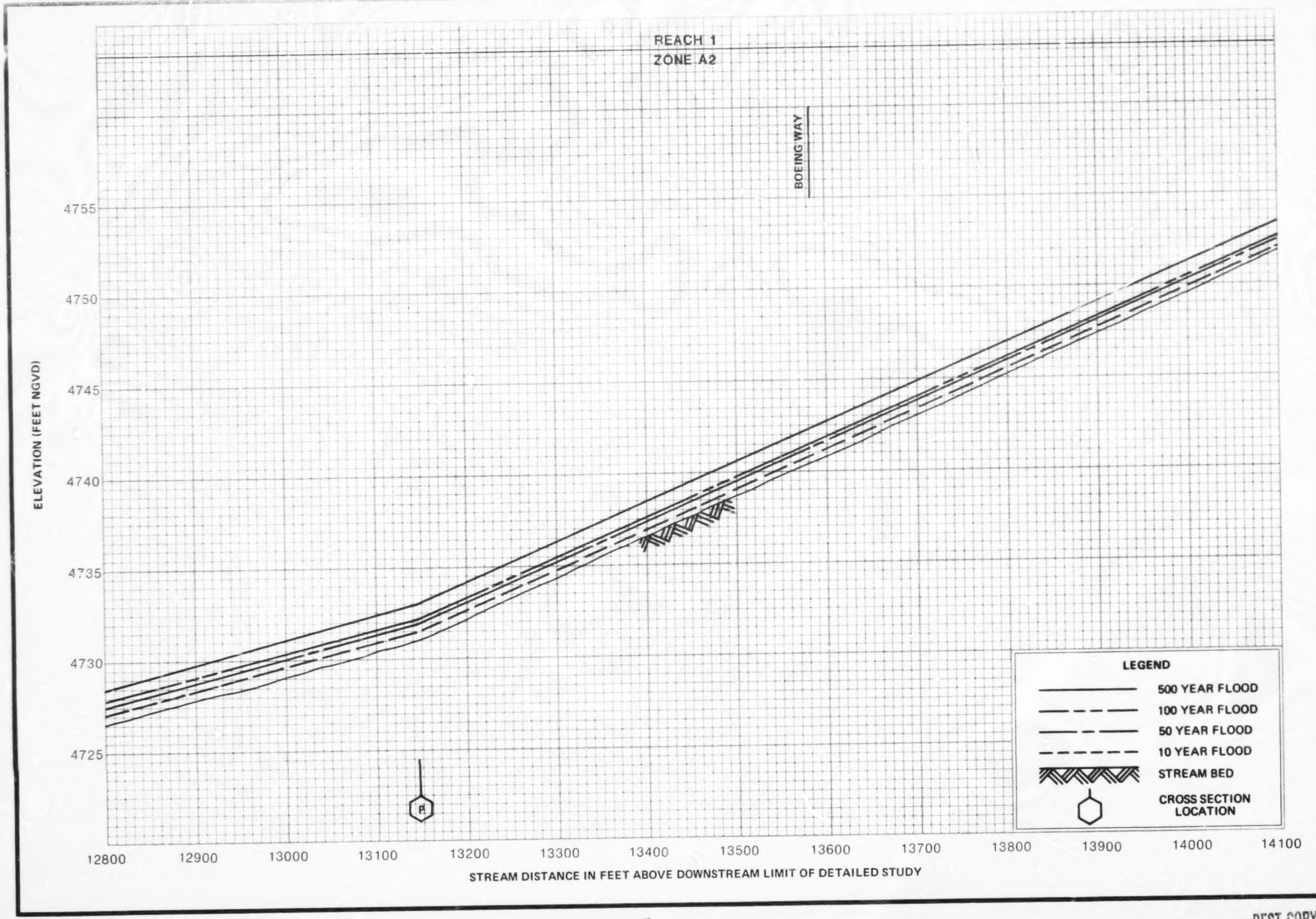

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GONI CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

26P

55

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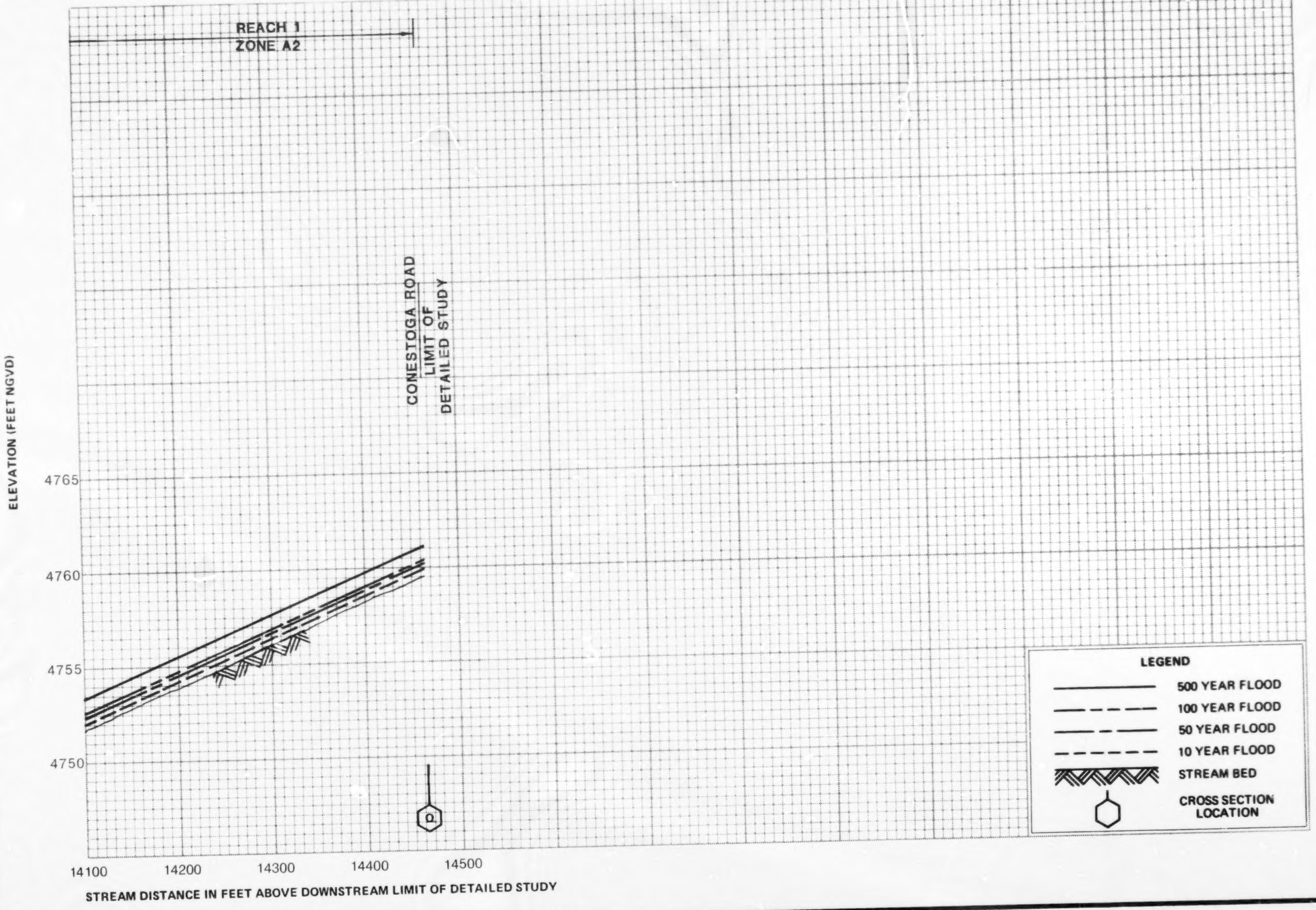

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GONI CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

27P

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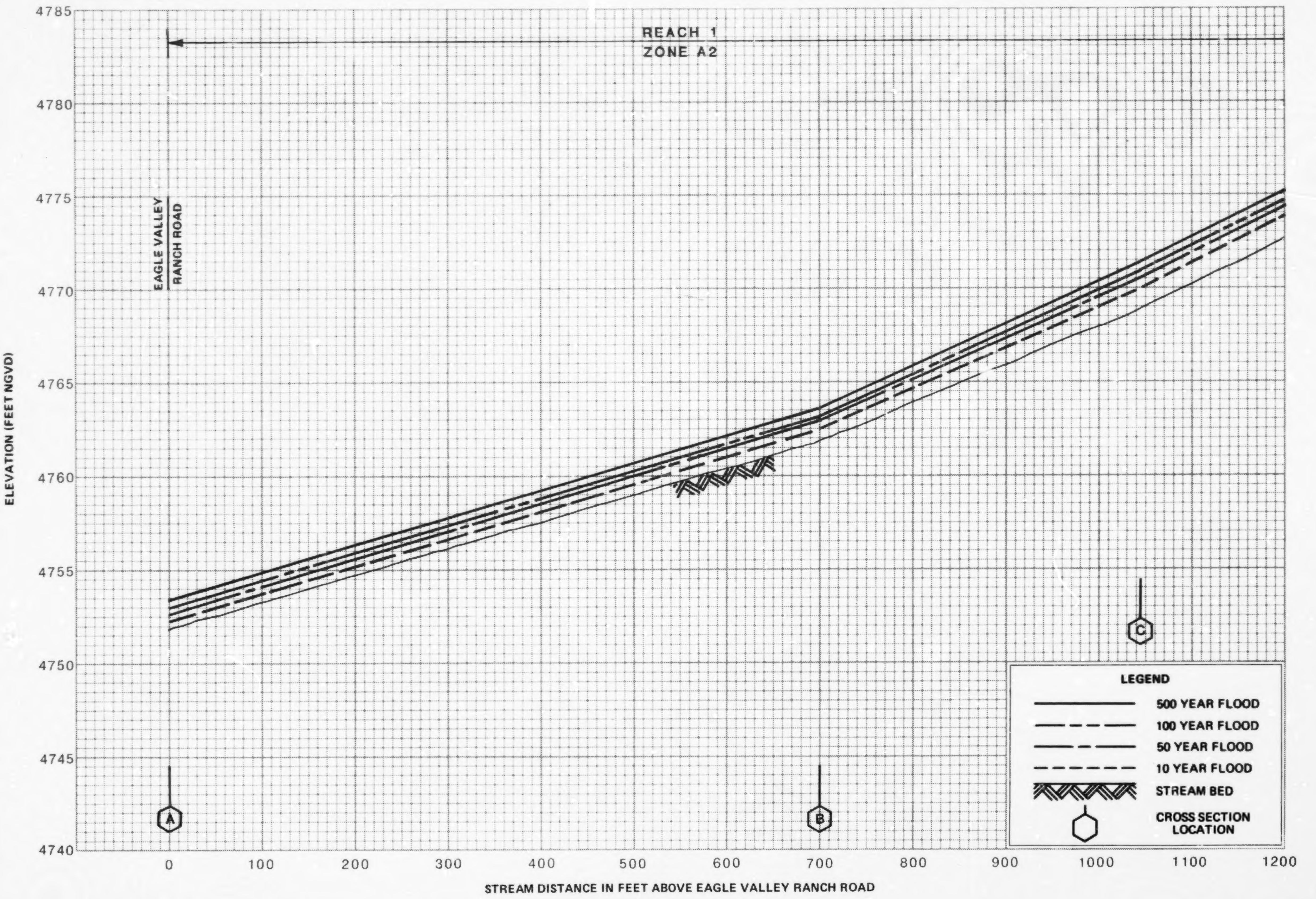


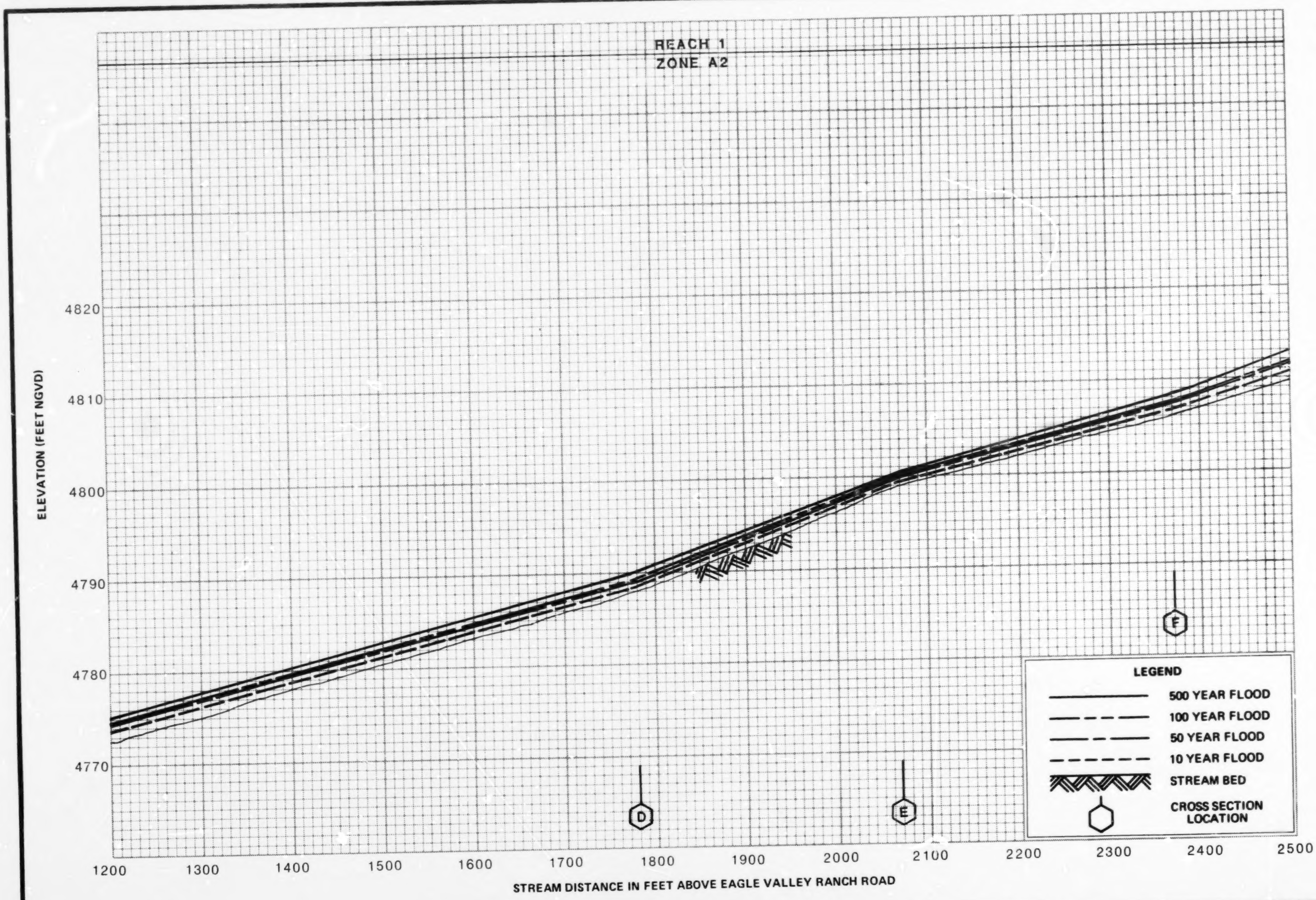
FLOOD PROFILE

EAGLE VALLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

28P



FLOOD PROFILE

EAGLE VALLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CARSON CITY, NV
(INDEPENDENT CITY)

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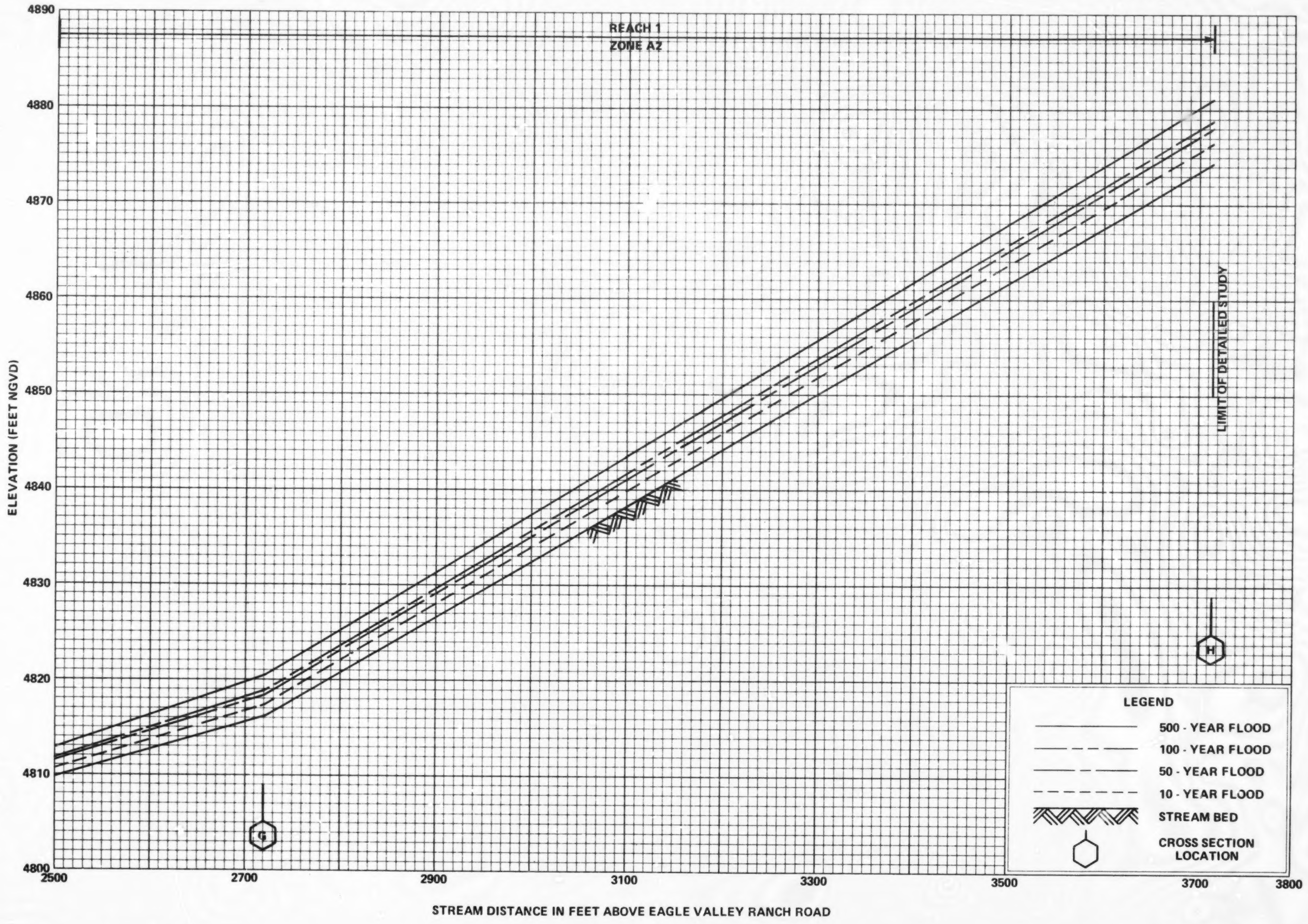

FLOOD PROFILES

EAGLE VALLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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(INDEPENDENT CITY)